

# 593 BALL VALVES

VALVE #	SIZE	MARK	O RINGS	TEST BEFORE TEFLON	BALL SENT TO TEFLON	TEFLON BALL TEST	SHIPPED OR REMARKS
b(3) 10 USC 130			6230-5 6230-42	(BALL USED) OK	OK		11-27-62
		4	"				BALL NO 11-27-62
		9	"				11-27-62
		8	"	OK	OK	OK	11-27-62
		00	"				11-27-62
		11	"				11-27-62
		X-7	"	OK	OK	OK	10-9-62
		3-4	"	OK	OK	OK	10-9-62
		33	"	OK	OK	OK	10-9-62
		5	"	DUTCHMAN VLV TO GO			12-6-62
		10	"				11-23-62
TD 145	4"	2	6230-2 6230-37	OK	OK	OK	10-18-62
TD 170	2 1/2"	1	6230-16 6227-19	OK	OK	OK	10-15-62
CG-15	1/2"	PRICK-PUNCH	6227-10 6227-12	OK	OK	OK	10-12-62
CG-9	1/2"	1	"	OK	OK	OK	10-25-62
CG-10	1/2"	2	"	OK	OK	OK	10-25-62
SD 84	ROCKWOOD 2 1/2"	3		OK	OK	OK	11-5-62
b(3) 10 USC 130			6227-10 6227-27	OK	OK	OK	10-19-62
		4	6227-16 6230-6	OK	OK	OK	10-30-62
		PRICK-PUNCH	6230-25	OK	OK	OK	11-6-62
TD 29	3"	"		OK	OK	OK	11-7-62
TD 164	ROCKWOOD 3"	0		OK	OK	OK	10-30-62
SD 85	(BOTTOM HALF ONLY)	PRICK-PUNCH	(TESTED ON BOAT)	(BALL SENT TO TEFLON)			10-19-62
TD 1	4"	3	6230-2 6230-37	OK	OK	OK	10-9-62
b(3) 10 USC 130				OK	OK	OK	10-9-62
				OK	OK	OK	10-9-62
				OK	OK	OK	10-9-62
		EXHIBIT (143)-2		OK	OK	OK	10-9-62

**TESTING OF SUBMARINE SEA VALVES: (SS212-525) GLOBE, ANGLE, GATE,  
INCLUDING MANIFOLD**

**Procedure**

BUSHIPINST 9480.40

(a) Seat tightness tests shall be hydrostatic using clean water as the testing medium.

(b) Valves shall be seated using the values listed in the following table as the maximum allowable seating force applied to the handwheel.

Handwheel Dia.	Total Tangential Force(lbs) on Rim of Handwheel
Inches	Pounds
Below 5"	30
5	50
6	72
7	90
8	102
9	114
10	120
11	129
12	135
14	138
16	141
18	144
21	147

(c) Tests shall be so conducted that all seat leakage can be measured.

(d) Pressure shall be applied in the direction of normal flow. (For gate valves, the pressure shall be applied alternately on both sides of the disc with the opposite end open for inspection.)

**Tightness Criteria** - Unless otherwise specified in the contract or ordering data, or where valves are used in hazardous service where leakage cannot be tolerated.

**NOTE:** Hazardous service = Any component connected with nuclear plant per FF4-12-9480/9480/00-19 June 1961

(a) Metal to metal seated valves - b(3) 10 USC 130  
for valves less than (1) inch in size, a

maximum leakage rate of b(3) 10 USC 1 will be permitted.

(b) Soft Seated Valves = No seat leakage permitted. Visible signs of leakage shall be cause for rejection.

Ref. (2) = 9480/24 Ser. 648K-4-1498

26 July 1961

Hydrostatically shell test to 1-1/2 times the operating depth pressure. Any weeping porosity or permanent deformation shall be cause for rejection.

Ref. (3) = 9480/24 Ser. 648K-4-1498

26 July 1961

Seat Tightness test with pressure equal to the operating depth pressure. Leakage per (a) and (b) above.

The duration of this test shall be 10 minutes (minimum). No lubricants will be permitted on the seats or discs while this test is being performed.

PROCESS INSTRUCTIONS  
IND-PNS-1122 (Rev 6-57)

PORTSMOUTH NAVAL SHIPYARD

PROCESS INST. NO. 513 1C

X31

TITLE: **CLEANING AND CLEANLINESS MAINTENANCE FOR HIGH PRESSURE AIR, MAIN BALLAST TANK  
BLOW AND SHIPS SERVICE AIR SYSTEMS**

REVISION	ISSUE DATE
C	20 Jul 1962

ORIGINATED BY <u>Design</u> DIVISION		
SIGNATURE	CODE	DATE
(b) (6)	264	7-16-62
	260	7-16-62
	Rev	7-19-62

REVISIONS							
REV.	SIGNATURE	CODE	DATE	REV.	SIGNATURE	CODE	DATE
	CHKD:				CHKD:		
	APPD:				APPD:		
	CHKD:				CHKD:		
	APPD:				APPD:		
	CHKD:				CHKD:		
	APPD:				APPD:		

DISTRIBUTION:

140	230	243M	261	303(4)	380	262B	X56
200	232	244I	262	2305	385	340	X31(4)
2301	239(50)	246	263	271	303C	504	X38
210	240	249	264	377	320S (6)	573	
225	242	260	300	376	370	245L	
226	250	251	270	303B(10)			

Spec. Dist. List  
for Outside Activities

COVER AND 15 SHEETS

EX 145-1

513.1C  
Process Instruction No.

PROCESS INSTRUCTION 513.1C

Subj: Revision C; description of change

1. This Revision cancels and supersedes P.I. 513.1B dated 16 Jun 1960.
2. This Revision co-ordinates DM264B-83-61, Portsmouth Naval Shipyard Instruction 513.1B, Bureau of Ships Instruction 9490.9 ser 648L3-1471 of 4 Aug 1960.

EXH 145-2

MSB

PORTSMOUTH NAVAL SHIPYARD  
PORTSMOUTH, NEW HAMPSHIRE

513.1C  
Process Instruction

**TITLE:** Testing, Cleaning and Cleanliness Maintenance for High Pressure Air, Main Ballast Tank Blow and Ships Service Air Systems

**Ref:** (a) BUSHIPS INSTR 9490.4 CH 1 ser 648E-859 of 25 Apr 1960  
(b) BUSHIPS INSTR 9490.6 ser 648-2942 of 25 Jan 1960  
(c) BUSHIPS Dwg No. SS-549-1611038  
(d) BUSHIPS INSTR 9490.9 ser 648L3-1471 of 4 Aug 1960  
(e) BUSHIPS INSTR 9490.9 CH 2 ser 648L3-689 of 18 Dec 1961

1. **Purpose.** To establish the procedures for testing, attaining and maintaining a specified degree of cleanliness for air piping systems for new construction and repair. Cleanliness is required to enable operation without fouling hazards to operating mechanisms and equipment.

2. **Scope.** This Instruction applies to all pipe, fittings, manifolds, valves and components incorporated into High Pressure Air, Main Ballast Tank Blow and Ships Service Air Systems.

3. **Instructions.**

3.1 **GENERAL**

3.1.1 **Definition.** The grade of cleanliness for these systems is Grade B, a second degree cleanliness which results in surface free of grease, oil, scale and other foreign and loose particles.

3.1.2 **Equipment** - Portable cleaning and drying equipment shall be furnished and shall consist of tanks, steam heating coils, gages, centrifugal pump, dehydrator, separator, water jacket test equipment, dewpoint indicators, cleaning solution, filters, heat resistant hose, temperature monitoring equipment, and a source of filtered oil free air. The above equipment shall be used for preparing cleaning solution, filling or circulation of cleaning solution in piping, flushing and drying the piping upon completion of flushing and testing.

3.1.3 **Locations.** All fabrication and installation operations may be accomplished in any of the affected shops or areas of the Shipyard.

3.1.4 **Responsibility.** The cognizant Inspection Code shall witness and certify that all flushing, cleaning and testing procedures have been accomplished in accordance with the procedures established herein. Certification shall be as noted in Paragraph 3.1.5. A record of all tests shall be maintained by the cognizant Inspection Code.

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3.1.4.1 For overhauls, the cognizant Design Code shall furnish to the Production Shops, at their request, marked-up diagrams outlining the extent of cleaning, flushing and hydrostatic and air testing for shop assemblies and piping systems. Production shops are responsible for attaining and maintaining required cleanliness. During the overhaul of operating submarines, a diagram shall be maintained of each air system with each entry (non-mechanical) into the piping system recorded thereon.

3.1.4.2 For overhaul ships, ship's force may be substituted for Shipyard Inspection Codes. A record of all tests and acceptances must be maintained by the cognizant Shop or Code.

3.1.5 Flushing and Testing Identification

To verify that all sub-assemblies and shipboard installed systems have been flushed and tested in accordance with requirements of this Process Instruction, color coded crimp type or lock type seals and acceptance slips shall be used. Air test seals shall be embossed, stamped or otherwise marked with the month and year of the last test.

3.1.5.1 Color seals and acceptance slips to be used as follows:

<u>Operation</u>	<u>Sup-Assemblies</u>	<u>Shipboard Systems</u>
Hot solution flush	Plain seal	Acceptance slip
Hot water flush	Red seal	Acceptance slip
Water Test	Green seal	Acceptance slip
Dryness Test	Blue seal	Acceptance slip
Air Test	White seal	Acceptance slip

NOTE: Color seals shall be attached at the completion of each test or flush. As one test or flush is completed, a new seal shall be attached.

3.2 SHOP ASSEMBLY

3.2.1 Abrasive blasting, chipping or grinding is not permitted in the vicinity of fabrication of air system assemblies.

3.2.2 Pipe or tubing shall not be packed with sand during the bending process.

3.2.3 Pipe or tubing that has had heat applied at the site of installation to assist in forming shall be returned to shop for re-cleaning and re-testing.

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3.2.4 All pipe tubing and fittings shall be thoroughly cleaned prior to installation aboard ship. They shall be free from scale, grease, oil and other foreign and loose particles.

3.2.5 Pre-cleaning. Remove grease, oil and shop dirt by immersing the work in sufficient quantity of the following trisodium phosphate solution at  $200^{\circ} \pm 10^{\circ}\text{F}$  for 15 minutes or longer depending upon the degree of contamination. The trisodium phosphate solution shall contain the following percentages by weight:

Trisodium Phosphate (Spec O-S-642 .....	5 to 10%
Nonionic Detergent (Polyethylene Glycol Monoalkylaryl Ether, Spec. MIL-D-16791, Type I).....	1%
Filtered Tap Water .....	89 to 94%

3.2.5.1 Rinse thoroughly in warm water (at least  $120^{\circ}\text{F}$ ) to neutralize trisodium phosphate solution.

3.2.6 Cleaning and Testing. After completion of welding and brazing, assemblies shall be cleaned and tested as follows:

3.2.6.1 All temporary lines, hoses, pumps, fittings, etc. shall be cleaned prior to use and shall be capped or sealed when not in use.

3.2.6.2 Hot flush for one (1) hour using filtered tap water at  $180^{\circ}\text{F}$  making sure that the temperature at any part of the system does not go below  $110^{\circ}\text{F}$ . Water may be recirculated through the filter. Filter shall have the same particle removal capabilities as required by system.

3.2.6.3 Hydrostatic Test - After flushing, the assembly shall be subjected to the applicable test pressure specified by the piping plan.

3.2.6.4 If leaks occur, they shall be repaired; and the assembly shall be reflashed and retested as specified above.

3.2.6.5 Following flushing, the assembly or system shall be completely drained and free water blasted out with clean oil free filtered dry nitrogen or air having a dew point range from  $-20^{\circ}\text{F}$  to  $0^{\circ}\text{F}$  at the dehydrator outlet. After all pockets are drained, each individual leg shall be blown dry starting with the highest leg and working toward the lower legs. Completion of system drying may be accomplished by blowing down several legs at one time. Shipyard air at 70 to 100 PSIG may be used for blowing down system provided that all air passes through a separator, oil removal filter (similar to CUNO model 1H1-2278-B2) and dehydrator to give air with the dew point specified above.

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3.2.6.6 Check every drain connection for moisture by a dew point indicator, model RAF-DPI, manufactured by Robbins Aviation, Inc. or equal. The dew point at drain connections shall not be more than 10°F. above that at dehydrator outlet.

3.2.6.7 Sealing or Capping - Caps or seals shall be fitted to each opening immediately after the cleaning and drying operation. All openings shall be kept sealed or capped except when access is necessary. Metallic plugs, caps and blanks shall be used for sealing openings. Plastic caps, rags, wooden plugs, cardboard or tape shall not be used, but plastic sealing tape may be used to hold caps in place. Plastic bag containers may be used for sealing small items. Plastic bags secured with plastic tape shall not be issued as a temporary seal over ends of pipe during shipping or transit of piping for shipboard installation.

3.3 SHIPBOARD INSTALLATION - NEW CONSTRUCTION

3.3.1 Receipt - subassemblies, pipe, valves or components received for shipboard installation shall be adequately capped or sealed to preserve their cleanliness. Items received with inadequate caps or seals shall be considered unsatisfactory and will be returned to the cognizant production shop for recleaning. Openings of all items shall remain capped until access is necessary.

3.3.2 Preparations - Before caps or seals can be removed for shipboard fabrication, the immediate work area, especially the overhead, shall be wiped, brushed and/or vacuum cleaned. Machining, welding, grinding, burning or any other operation which creates dirt shall not be progressed in the immediate vicinity of any piping or unit that is open. If, in the opinion of the Ship Superintendent, dirty work must continue, a temporary enclosure shall be installed around the piping to be opened. This enclosure will be suitably installed to prevent the possibility of any dirt entering the open pipe or unit. Partially installed systems will have all openings capped or plugged whenever they must be left unattended.

3.3.3 Preparation for Cleaning

3.3.3.1 Vendor-furnished components that have been cleaned and capped at the factory will not require disassembly for cleaning unless a cap or plug has been lost and/or the equipment is contaminated.

3.3.3.2 Cleaning valves and small or delicate equipment. After degreasing of these components with trichloroethylene (Fed. Spec. O-T-34) or Freon "TF", they shall be capped. Degreasing of these components with a

detergent cleaning solution is not permissible.

3.3.3.3 Capping or Sealing - Caps or seals shall be fitted to each opening immediately after the cleaning and drying operations. All openings shall be kept sealed or capped except when access is necessary. Metallic plugs, caps and blanks shall be used for sealing openings. Plastic caps, rags, wooden plugs, cardboard or tape shall not be used, but plastic sealing tape may be used to hold caps in place. Plastic bag containers may be used for sealing small items. Plastic bags secured with plastic tape shall not be used as a temporary seal over ends of pipe during shipping or transit of piping for shipboard installation.

3.3.4 Cleaning and Testing - Those portions of the system contaminated by shipboard welding or brazing shall be cleaned and tested as follows:

3.3.4.1 All temporary lines, hoses, pumps, filter, fittings, etc. shall be cleaned prior to use and shall be capped or sealed when not in use.

3.3.4.2 Hot flush for one (1) hour using filtered tap water at 180°F. making sure that the temperature at any part of the system does not go below 110°F. Filter shall have the same particle removal capabilities as required by system.

3.3.4.3 Hydrostatic Test - After flushing, the assembly shall be subjected to the applicable test pressure specified by the piping plan.

3.3.4.4 If leaks occur, they shall be repaired and the assembly shall be reflashed and retested as specified above.

3.3.4.5 Following hydrostatic test and repair of leaks, the assembly or system shall be completely drained and free water blasted out with clean oil free filtered dry nitrogen or air having a dew point range from -20°F to 0°F at the dehydrator outlet. After all pockets are drained, each individual leg shall be blown dry starting with the highest leg and working toward the lower legs. Completion of system drying may be accomplished by blowing down several legs at one time. Shipyard air at 70 to 100 PSIG may be used for blowing down system provided that all air passes through a separator, oil removal filter (similar to CUNO model 1H1-2278-B2) and dehydrator to give air with the dew point specified above.

3.3.4.6 Check every drain connection for moisture by a dew point indicator, Model RAF-DPI, manufactured by Robbins Aviation, Inc. or

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equal. The dew point at the drain connections shall not be more than 10°F. above that at the dehydrator outlet.

3.3.5 Remove flushing blocks and replace with appropriate valve. Remove temporary jumpers and reconnect piping to components.

3.3.6 Charge air banks to system working pressure and conduct system air tests per applicable test memos.

#### 3.4 SHIPBOARD INSTALLATION - Contaminated Systems for New Construction or Repair Ships.

3.4.1 The following procedure shall be used to inspect air systems suspected of being contaminated with lubricating oil, hazardous materials or other contaminant such as sea water.

3.4.2 When inspection indicates the presence of lubricating oil in the piping or components in amount more than a light film-coating, the system shall be cleaned. A light film-coating is that obtained when an oil-coated surface is wiped off thoroughly with a rag.

3.4.2.1 Inspection of suspected air system shall be accomplished by collecting and examining blowdown from all air flasks, separators, low point drains, etc., and by disassembly of selected piping sections and components downstream of the compressor discharge.

3.4.2.2 Blowdown shall be accomplished by cracking the drain valve slowly and blowing to a clean container until air begins to escape.

3.4.2.3 Select representative sections of piping and components for disassembly and inspection.

3.4.2.4 Examine collected sample for oil content and other contaminants. Submit analysis to cognizant code via condition reports for recommended remedial action.

#### 3.4.3 Cleaning Procedure for Contaminated Systems

3.4.3.1 Disconnect piping from air compressors, desiccant-type dryer, filters, cylinders, and other components which may be adversely affected by the cleaning solution (see Para. 3.4.3.7.1).

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3.4.3.2 Install temporary jumpers around each component that has been disconnected. Temporary jumper lines shall be of the same size as the lines to which they are attached.

3.4.3.3 Flushing blocks shall be used in lieu of jumpers when they are provided. Valve list for appropriate vessel designates those components for which Design Division has provided flushing blocks.

3.4.3.4 If system lines are cut, and brazed or welded fittings added, that portion of the system shall be hydrostatically tested to  $1\frac{1}{2}$  times system working pressure.

3.4.3.5 Portable cleaning equipment consisting of tanks, steam heating coils, centrifugal pump and filter shall be used for preparing cleaning solution, filling or circulating cleaning solution in piping, and flushing.

3.4.3.6 Solution - Use the following proportions by volume for flushing:

Renex HLB 10.7

(1 Part Renex 678, 4 Parts Renex 648)-----0.2%  
Wilmington, Del.

Onamine R. O. Emulsifier -----0.8%  
Manufacturer, Onyx Oil & Chemical Co., Jersey City, N. J.

Filtered Tap Water----- 99%

The following procedure, based on 100 gallons of cleaning solution, should be used for making up the solution:

- (1) Heat 20 gallons of filtered tap water in a tank to 140°F.
- (2) Add 21 oz. of Renex 648 and mix thoroughly.
- (3) Add 5 oz. of Renex 678 and mix thoroughly.
- (4) Maintain temperature at 140°F.
- (5) Add 3.2 qts. of Onamine R. O. and stir thoroughly until completely mixed.
- (6) Add filtered tap water until tank contains 100 gallons of solution

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(7) Heat solutions to 140°F.

3.4.3.7 Fill the system with filtered detergent cleaning solution and circulate for two (2) hours with the solution at about 140°F. in tank. Filter shall have the same particle removal capabilities as required by system.

3.4.3.7.1 Components which cannot be cleaned integrally with the piping shall be cleaned separately after disassembly, if necessary, by soaking, circulating or scrubbing with the same solution or with Freon "TF". Desiccant charges shall be renewed; reuseable filter elements cleaned and noncleanable filter cartridges replaced.

3.4.3.8 Drain system.

3.4.3.9 Refill system with above cleaning solution and circulate for an additional two (2) hours.

3.4.3.10 Drain system.

3.4.3.11 Flush twice with filtered tap water at ambient temperature. Filter to have the same particle removal capabilities as required by system.

3.4.3.12 Following flushing, the assembly or system shall be completely drained and free water blasted out with clean oil free filtered dry nitrogen or air having a dew point range from -20°F to 0°F at the dehydrator outlet. After all pockets are drained, each individual leg shall be blown dry starting with the highest leg and working toward the lower legs. Completion of system drying may be accomplished by blowing down several legs at one time. Shipyard air at 70 to 100 PSIG may be used for blowing down system provided that all air passes through a separator, oil removal filter (similar to CUNO model 1H1-2278-B2) and dehydrator to give air with the dew point specified above.

3.4.3.13 Check every drain connection for moisture by a dew point indicator, Model RAF-DPI, manufactured by Robbins Aviation, Inc. or equal. The dew point at drain connection shall not be more than 10°F. above that at the dehydrator outlet.

3.4.3.14 Remove flushing blocks and replace with appropriate valve. Remove temporary jumpers and reconnect piping to components.

3.4.3.15 Pressurize the system to its working pressure and soap mechanical joints and any new fittings for leaks. For new construction, a system pressure drop test need not be repeated provided one has been completed.

3.5 SHIPBOARD INSTALLATION, OVERHAUL AND REPAIR

3.5.1 Whenever components or sections of piping are removed from the system, all openings shall be immediately capped or sealed. Only metallic plugs, caps and blanks shall be used for sealing the openings.

3.5.2 Whenever pipes have to be cut and/or repairs have to be made by welding or brazing, the system or subsystem shall be tested and cleaned as follows:

3.5.2.1 Vendor-furnished components that have been cleaned and capped at the factory will not require disassembly for cleaning unless a cap or plug has been lost and/or the equipment is contaminated.

3.5.2.2 Cleaning valves and small or delicate equipment. After degreasing of these components with trichloroethylene (Fed. Spec. O-T-34) or Freon "TF" they shall be capped. Degreasing of these components with a detergent cleaning solution is not permissible.

3.5.2.3 New pipes and fittings to be installed in overhaul ships shall be precleaned to remove grease oil, and shop dirt by immersion of the work in sufficient quantity of the following trisodium phosphate solution at  $200^{\circ} \pm 10^{\circ}\text{F.}$  for 15 minutes or longer, depending upon the degree of contamination. The trisodium phosphate solution shall contain the following percentages by weight:

Trisodium phosphate Spec (O-S-642)---	5 to 10%
Nonionic detergent (Polyethylene Glycol Monalkylar1 ether Spec. MIL-D-16791, Type I - - - - -	1%
Tap Water - - - - -	89 to 94%

3.5.2.3.1 Rinse thoroughly in warm water (at least  $120^{\circ}\text{F.}$ ) to neutralize trisodium phosphate solution.

3.5.2.4 Capping or Sealing - Caps or seals shall be fitted to each opening immediately after the cleaning and drying operations. All openings shall be kept sealed or capped except when access is necessary.

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Metallic plugs, caps and blanks shall be used for sealing openings. Plastic caps, rags, wooden plugs, cardboard or tape shall not be used, but plastic sealing tape may be used to hold caps in place. Plastic bag containers may be used for sealing small items. Plastic bags secured with plastic tape shall not be used as a temporary seal over ends of pipe during shipping or transit of piping for shipboard installation.

3.5.2.5 Cleaning and Testing - Those portions of the system contaminated by shipboard welding or brazing shall be cleaned and tested as follows:

3.5.2.5.1 - All temporary lines, hoses, pumps, filter, fittings, etc., shall be cleaned prior to use and shall be capped or sealed when not in use.

3.5.2.5.2 - Hot flush for one (1) hour using filtered tap water at 180°F. making sure that the temperature at any part of the system does not go below 110°F. Filter shall have the same particle removal capabilities as required by system.

3.5.2.5.3 Hydrostatic Test - The assembly shall be subjected to the applicable test pressure specified by the piping plan. A hydrostatic test is not required for air-conditioning control air systems.

3.5.2.5.4 - If leaks occur, they shall be repaired, and the assembly shall be retested as specified above.

3.5.2.5.5 - Following flushing, the assembly or system shall be completely drained and free water blasted out with clean oil free filtered dry nitrogen or air having a dew point range from -20°F to 0°F at the dehydrator outlet. After all pockets are drained, each individual leg shall be blown dry starting with the highest leg and working toward the lower legs. Completion of system drying may be accomplished by blowing down several legs at one time. Shipyard air at 70 to 100 PSIG may be used for blowing down system provided that all air passes through a separator, oil removal filter (similar to CUNO model 1H1-2278-B2) and dehydrator to give air with the dew point specified above.

3.5.2.5.6 - Check every drain connection for moisture by a dew point indicator, Model RAF-DPI manufactured by Robbins Aviation, Inc. The dew point at the drain connections shall not be more than

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10°F. above or equal that at the dehydrator outlet.

3.5.2.5.7 - Remove flushing blocks and replace with appropriate valve. Remove temporary jumpers and reconnect piping to components.

3.5.3 After the satisfactory hydrostatically testing and drying, the systems, with all instruments and equipment included, shall be charged with air (the ship's air compressor may be used for charging) to a pressure equal to the design working pressure of the system. Air from Yard air compressors shall be passed through an oil filter similar to CUNO Model (1H1-2278-B2). The compressed air shall be allowed to stand in the system to equalize the temperature. The pressure drop corrected for temperature changes shall not exceed the percentage of the test pressure given below in the given time:

TEST PRESSURE IN PAI	TIME IN HOURS	PRESS. DROP IN PERCENT OF TEST PRESS.
1000 and above	24	1
Below 1000	6	5

In conducting the test, air flask temperature shall be taken directly by means of an attached externally insulated thermometer or by use of thermocouples. Readings shall be taken at least once each hour. In addition, the air temperature in the flask, storage area temperature, shall be recorded each hour.

If, at the expiration of the test period, the pressure drop exceeds the permissible percentage drop, a soapy solution shall be applied to the joints, the system shall be examined, leaks shall be corrected and the test repeated. If repairing of leaks introduces foreign matter into a system, those portions affected shall be reflashed and hydrostatically tested before repeating the drop test. Drop tests to be conducted shall extend to boundary valves or dead ended lines for each system being tested. A boundary valve is defined as the last system valve before the air enters a reduced pressure service or before entering a tank.

Pressure drop tests are not required for systems such as air-conditioning control, MBT blow piping downstream of the MBT blow solenoid valves, and other systems for which pressure drop tests may be impracticable because of the multiple components involved. Such systems shall be charged with air to the design working pressure of the system and all joints visually checked for leaks. All leaks shall be corrected and the test repeated

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as necessary to insure that there are no leaks in the system.

Upon completion of the tightness tests, all systems shall be operated with air at the operating pressure to determine the satisfactory operation of each system, and of system components such as check valves, relief valves, automatic cut-out valves, reducing valves and gages, and to determine that each system satisfies the specified requirements.

3.5.4 Mechanical joints such as unions at manifolds, solenoid valves and at air flasks which are not ordinarily connected during hydrostatic tests shall be soap-tested for leaks with air at system pressure.

3.6 Air Flasks

3.6.1 Procedure for cleaning flasks.

3.6.1.1 After initial inspection by borescope to determine the extent of corrosion, clean flask interior as needed by sandblasting, shotblasting or tumbling, to remove all corrosion products and internal coating and obtain a clean metal surface.

3.6.1.2 Clean flask exterior as needed by sandblasting or rotary wire brush.

3.6.1.3 Rinse flask with hot filtered tap water (180°F. min.). Filter to have the same particle removal capabilities as required by system.

3.6.1.4 Dry flask with clean, dry oil-free filtered air or nitrogen.

3.6.1.5 Protect all threads against physical damage during cleaning operations.

3.6.2 Procedure for inspecting flasks.

3.6.2.1 Visually inspect flask exterior for dents, deformation and corrosion. Any flask that is dented or deformed shall be rejected and drilled to prevent further use.

3.6.2.2 Inspect the cleaned interior surface of the flask with the aid of a borescope to determine the location and extent of corrosion or other harmful conditions. On the outside of the flask, mark the location

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of those internal areas showing severest corrosion. Survey these areas very carefully with the aid of ultrasonic inspection equipment and determine the minimum remaining wall thickness. Ultrasonic inspection shall be conducted in accordance with the requirements of Military Standard MIL-STD-271. If the wall thickness at any point falls below the minimum acceptable wall thickness shown in Table I (below), the flask shall be rejected and drilled to prevent further use. Flasks exhibiting no corrosion need not be ultrasonically inspected.

TABLE I			
APPLICABLE SPEC	DESIGNED WORKING PRESSURE (PSI)	FLASK DIAMETER (INCHES)	MINIMUM ACCEPTABLE WALL THICKNESS (INCHES)
51F5 or MIL-C-15111	b(1)	5-1/4 I. D.	0.21
		16 I. D.	0.64
MIL-C-15111		5-1/4 I. D.	0.35
		16 I. D.	1.07
51F10 or MIL-C-2809		18 O. D.	0.43
MIL-F-22606		6-5/8" O. D.	.49
		18" O. D.	.56
		18" O. D.	1.063

NOTE: Applicable specification and working pressure are stamped on the end of the flask.

3.6.2.3 All flasks passing visual and ultrasonic inspection shall be hydrostatically tested to 1-2/3 working pressure and the deformation measured by the water jacket test (below).

3.6.2.4 Water Jacket Test - For hydrostatic test, the Water Jacket Leveling Burette Method of hydrostatic testing as outlined in reference (d) shall be used. (NOTE: Copies of reference (d) can be obtained from the Compressed Gas Association, Inc., 11 West 42nd Street, New York, New York).

513.1C  
Process Instruction

3.6.2.5 Flasks passing the hydrostatic test shall be dried immediately to prevent corrosion.

3.6.2.6 All flasks failing the hydrostatic and/or deformation test shall be rejected and drilled to prevent further use.

3.6.3 Procedure for coating flasks - (NOTE: Flasks should be coated in accordance with reference (e) as soon after cleaning and inspecting as possible in order to minimize surface rusting).

3.6.3.1 All flasks passing complete inspection shall be coated internally and externally as specified below.

3.6.3.2 Insure that surfaces to be coated are clean and dry.

3.6.3.3 Internal Coating - Ships having air compressors lubricated with petroleum lubricants, such as 2190 TEP, shall have the internal surfaces of their flasks coated with the following zinc chromate system:

3.6.3.3.1 One coat of wash primer, Formula 117, Specification MIL-P-15328.

3.6.3.3.2 Three coats of vinyl zinc chromate Formula 120, Specification MIL-P-15930 .

3.6.3.4 External Coating - The exterior surfaces of all high pressure air steel flasks shall be coated with the above zinc chromate system.

3.6.3.5 Inerting - Flasks shall be thoroughly dried prior to inerting. All flasks shall be evacuated to 29 millimeters (mm) of mercury or less; while under this partial vacuum, the flasks shall be filled with nitrogen to a pressure of 5 to 7 PSI. Commercial nitrogen that is clean, dry and oil-free shall be used. The nitrogen in the flasks shall be sealed by a metal plug selected from those shown on Figure 9 of MIL-F-22606.

3.6.4 Frequency of Inspection

3.6.4.1 Moisture separators, dehydrator towers and filter bowls shall be disconnected and removed from the ship at intervals of not more than three (3) years for purposes of maintenance.

513.1C  
Process Instruction

3.6.4.2 Remove all flasks, including impulse flasks, from ship at intervals of not more than six (6) years for purposes of inspection and maintenance.

3.7 Thread lubricants for high pressure air system shall be "Molykote Type Z Powder" (Stock No. GL 8030-L00-2053), manufactured by Alpha Molykote Corp. 65 Harvard Ave., Stamford, Conn. This lubricant is authorized by BUSHIPS INST. No. 9230.15A of 19 June 1962.

POST SHAKEDOWN AVAILABILITY SS(N)593

PLAN	SYSTEM	JOINT NO.	SIZE	LOCATION	DATE
DL115040	Air Cond. Salt water pipe	FL2-F25	b(3) 10 U	Fr 81 Port Engine Room	2-1-63
DL115040	Air Cond. Salt water pipe	F67-F65		Fr 80 Port Engine Room	1-5-63
DL115040	Air Cond. Salt water pipe	F67-F25		Fr 78-80 Port Engine Room	1-5-63
DL115040	Air Cond. Salt water pipe	F67-F67A		Fr 81 Port Engine Room	1-31-63
DL115040	Air Cond. Salt waterpipe	P-28-F67		Fr 81 Port Engine Room	1-31-63
1862775	Cu Ni Trim & Drain	F25-F1	4.5	Fr 14 Port Sonar Sphere	10-27-62
"	"	F-26-F2	4.5	Fr 11 Port Sonar Sphere	10-27-62
"	"	F-27-F1	3.5	Fr 14 Port Sonar Sphere	11-2-62
"	"	FL1-F2	4.5	Fr 14 Port Sonar Sphere	10-27-62
"	"	P13-1-F2	4.5	Fr 14 Port Sonar Sphere	12-7-62
"	"	F1-P13-1	4.5	Fr 14 Port Sonar Sphere	11-2-62
"	"	F-2-F25	4.5	Fr 14 Port Sonar Sphere	10-27-62
"	"	P13-1-F26 1P13-1-F26 Same joint	4.5 4.5	Fr 13 Port Sonar Sphere	11-26-62
1862718	Air Cond. Salt water	FL1-FL13	b(3) 10 U	Fr 82 Port Engine Rm.	12-7-62
"	"	FL2-Ext. Nipple		Fr 80-81 Port Engine Rm.	11-2-62
"	"	FL2-F25		Fr 81-82 Port Engine Rm.	12-29-62
"	"	FL2-P-27		Fr 80 Port Engine Rm.	2-4-63

EXHIBIT (146)-1

1862718	Air Cond. Salt Water	F13-Added Nipple	b(3) 10 U	Fr 81-82 Port Engine Rm.	10-25062
"	"	F13-P28		Fr 81 Port Engine Rm.	2-4-63
"	"	F13-P28-1		Fr 81 Port Engine Rm.	1-21-63
"	"	P-18-F18		Fr 82 Port Engine Rm.	1-30-63
"	"	F25- Ext. For		XX. E.R.	1-18-63
"	"	F25- to Nipple		Shpp Welded Engine Rm.	1-24-63
"	"	F25 to F25 E		Fr 80 Port Engine Rm.	2-6-63
"	"	F25 to F26		Fr 79-81 Port Engine Rm.	12-24-62
"	"	F25 to P28		Shop Welded	11-24-62
"	"	F25 to F67		Fr 81 Port Engine Rm.	1-31-63
"	"	F26 to F67		Fr 80 Port Engine Rm.	2-7-63
"	"	P-27 to F26		Shop Welded Engine Rm.	10-25-62
"	"	P28-1 to F25		Fr 81 Port Engine Rm.	12-29-62
"	"	F67 to P28		Fr 80 Port Engine Rm.	XXXX 2-4-63
"	"	F67 to F67		Fr 80-81 Port Engine Rm.	10-14-62
1943414	A.M.S. Trim & Drain	Pc16-45L to Pc6	4.5	Fr 71 Port A.M.S.	11-10-62
1862586	A.M.S. Aux. Salt Water	P1-FL5	b(3) 10 U	Fr 69 Port A.M.S.	2-22-63
"	"	P1-F11		Fr 69 Port A.M.S.	2-22-63



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

SS/9480  
Ser 648K-2340  
28 November 1962

From: Chief, Bureau of Ships  
To: Supervisor of Shipbuilding, U.S. Navy, Groton  
Supervisor of Shipbuilding, U.S. Navy, Quincy  
Supervisor of Shipbuilding, U.S. Navy, Camden  
Supervisor of Shipbuilding, U.S. Navy, Newport News  
Supervisor of Shipbuilding, U.S. Navy, Pascagoula  
Commander, Mare Island Naval Shipyard  
Commander, Portsmouth Naval Shipyard

Subj: Cast Aluminum Bronze Equipment or Components in Submarine  
Sea Water Service, Request for information concerning

Ref: (a) BUSHIPS ltr SS/9480 Ser 648K-724 of 3 April 1962

1. Results of corrosion tests of cast aluminum bronzes at Harbor Island and examination of shipboard components, normally exposed to sea water, have shown these materials to be susceptible to intergranular corrosion. Replies to reference (a), indicate that a large amount of cast aluminum bronze has been, and is being installed on submarine sea water applications.

2. In order to determine what replacement action is necessary, the following categories have been established in order of criticality and apply to items exposed to sea water during normal operation.

CATEGORY I

Hull and backup closures, where the failure of any part could cause malfunction or failure of the closure.

CATEGORY II

All pressure containing parts, other than those in Category I, whose failure would result in flooding (assuming a constant opening to the sea) as follows:

- a. Uncontrolled rate (non-surfaceable)
- b. Controlled rate (surfaceable)

78875

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CATEGORY III

All other castings exposed to sea pressure, the failure of which could prevent the ship from accomplishing its mission.

3. Addressees are requested to provide the data outlined hereinafter, for each of the above categories, for all components and equipment on order, being installed on ships under construction or now installed on operating ships, beginning with the USS NAUTILUS (SSN571). Castings of the following materials only, are to be included:

MIL-B-16033 Classes 1, 2, 3 and 4  
MIL-B-21230 Alloy 1 and 2  
ASTM-B-148 All Classes  
QQ-B-671 Classes 1, 2, 3 and 4

4. Specific data required is as follows:

- a. Category (SEE Paragraph 2)
- b. Item or equipment
- c. Application (service and location)
- d. Size
- e. Material specification, class or alloy and heat treatment
- \*f. Delay in ship if replacement required
- \*g. Increase in cost if replacement required

\*This information may be furnished at a later date if it will delay submission of the data requested in 4a, b, c, d and e.

5. For the information of all addressees, the following cast materials are considered suitable from a corrosion standpoint for sea water applications:


Composition M - MIL-B-16541  
Composition G - MIL-M-16576  
Copper nickel alloy (70-30) - MIL-C-20159  
Monel - QQ-N-288  
Nickel Aluminum Bronze - MIL-B-16033 Class 4 (minimum of 4% nickel)  
Nickel Aluminum Bronze - MIL-B-21230 Alloy 1 (minimum of 4% nickel)

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Ser 648K-2340

6. Where follow yards duplicate lead yard installations, only the item identification, ship delay and or increase in cost, need be reported since these will vary with each shipyard.

7. The data required in paragraph 4a, b, c, d and e and in 4f and g if possible, is requested by 15 December 1962 for ships under construction and material on order. Data for operating ships should be provided as soon as practicable thereafter.

(b) (6)

 JAMES E. CALLAHAN  
By direction

SSN 393 Thresher  
Plan of Day 3-7-63

		Comp	Action
* A.S.W. system	hydro	3/7 <del>3/6</del>	38/56 303
WRT #2	probe inst X51 studs.	3-7	51/72 71/303
Air regen. room -	mod. fans comp 3-7-1800 repair pump - piping		11/56 31/38
Broken line ripper	cont. vtr. in X31		31/38 303
St. + Dir.	piping comp 3-6 tuning chk on hyd. vtr. or take tube Elec. chk. (40) 0800	3/9	56/38 51
Trim flow meter test	gage problem	3-6	57/303
calibrate tanks	comp 3-9. (form plet)		
Crews Washroom	X17 work X51 dryers + lights	3-8 3/8.	87/51
E.C.M. mast	auto-comp.	3-7	67/38
8B Scope.			
Trash ejector	X56 test	3-7	56
X56 equalizer line			
Bld 52	USK stowage Complete	3-6	17
Engine room	X38 engs X51 DLI ST. DIV. " hyd. DLI(160/6) Puffa X71 Paint (1) light Complete X72 clean " ASW X17 lockers		
Oxygen system	union being seal welded		26/56
Off. Comp	Work done.		
Puffa air system	#2 8-7 - #3 3-5 -		56
air system drop test	b(1) on 2+4	3-7	56
EXH 151-1	top (3-7)	3/7 151	

	Comp	Action
Thrust collar - resonance changer 303 insp 3-7      piping comp 3-6		56/51 303
Torp. shipping      ships vent 3-7		38
Messenger Buoy - Pull test -	3-7	11/72
Vent. Bal.      Code 246	3-7	17
Torp. Tube doors - X ray #2 comp 3-7		38/ 303
Thrust collar - XI7 removal of interferometer check. J.O. 50801 - Heat run belg stepping pumps.		

EXH 151-2

Crit

USS(N) 593 PLAN OF THE DAY 3-8-63		COMP	ACTION
ASW SYSTEM - HYDRO	Ring replacement	3-8	56
WRT. #2 - PROBE INST.	PAINT TOUCHUP		72/71 5/303
BOWEN LINE WIPER -	CONTINUE TO CORRECT X38	3-8	38/303
3T4 DIV. -	TIMING CHECK ON HYD. VALVES ELECT. CHECK - HYD VALVES IN TARP RM	(40) 3-8	54/58 51
TRIM TANKS -	COMP 3-8	3-8	51/303
CREWS WASH ROOM -	HAND DRYERS - LIGHTS - X17 COMP	3-8	17/51
E.C.M. MAST -	X67 AUTO COUNTER X38	3-8	67/38 C3D
8-B SCOPE -	X38 CORRECT YOKE PROBLEM REINSTALL 3/8	3-8	38
TRASH EJECTOR -	X56 3 SHIFT TO COMP EQUALIZER LINE	3-8	56
ENGINE ROOM -	X71 - PAINT X72 - CLEAN X11 - DECK PLT. X51 - LIGHTS (DLI 16016 PUMPS) X38 HANDEAS " HYD. " ASW. X17 LEAKS	3-11	
OXYGEN SYSTEM -	UNIONS BEING RECAL WELD	3-8	26/50
PUFFS AIR SYSTEM #2 -	SEAL	3-8	56/303
AIR SYSTEMS - DROP TEST	(b(1)) COMP 3-8 STILL GO		54/303
THRUST COLLAR -	RESONANCE CHANGER SET SWITCHES 303 TM43-02-001 - X17	3-8	51/38 303/17
TORP. SHIPPING	SHIP VENT. 3/7-3/11		38
MESS. BUDY -	FULL TEST	3-8	72/58 003
VENT. BAL.	CODE 246 EVALUATE		17
TORP TUBE DOOR #2 TUBE -	X31 ASSEMBLE TO COMP 3-8 - X38 INSTALL.	3-8	31/38
BILGE STRIPPING SYSTEM.	X38 Lead ship -	3-8	56
SECURITY ALARM SYST. -	38-56-51-67		

(b) (6)

EXH 152

TABLE 3

Unclassified

Hull No.	1 Ship Name	2 Design Year	3 H.P. Air Flask Cap. Cu.Ft.	4 No. Air Banks	5 No. Air Flasks	6 H.P. Air Press	7 Water and Fuel Ballast Tank Cap. Cu.Ft.	8 Design Depth Ft.	9 % Water and Fuel Ballast Tanks Cap. Blown by H.P. Air at Design Depth (Isothermal Expansion)
1	Holland	1899	30	5	5	2000	310	100	425
2	Plunger (A-1)	1901	52	10	10	2000	585	150	255
9	Octopus (C-1)	1906	76	17	70	2500	1270	200	163
20	Carp (F-1)	1909	125	5	38	2500	2750	200	123
24	Skipjack (E-1)	1909	100	5	35	2500	2070	200	131
28	Seawolf (H-1)	1910	125	5	30	2500	2720	200	125
32	Haddock (K-1)	1911	140	5	32	2500	4450	200	85
40	L-1	1913	140		32	2500	3450	200	111
47	M-1	1913	153		60	2500	6650	150	83
53	N-1	1915	110			2500	2330	200	128
60	T2	1916	500		65	2500	13,300	150	136
71	U-10	1916	170	5	30	2500	3910	200	118
78	R-1	1917	150	5	26	2800	3780	200	121
05	S-1	1917	300	5	44	2800	7320	200	126
23	S-18	1917	300	5	44	2800	7320	200	126
47	H-4	1918	125		87	2500	2750	200	124
53	S-42	1919	317			2800	8250	200	117
57	Narwhal (V-5)	1926	958			3000	37,294	300	55

Unclassified

D.I.

E-453

Unclassified

EXH 153-1

TABLE 3 (Cont'd)

Unclassified

Hull No.	1 Ship Name	2 Design Year	3 H.P. Air Flask Cap. Cu.Ft.	4 No. Air Banks	5 No. Air Flasks	6 H.P. Air Press.	7 Water and Fuel Ballast Tank Cap. Cu.Ft.	8 Design Depth Ft.	9 % Water and Fuel Ballast Tanks Cap. Blown by H.P. Air at Design Depth (Isothermal Expansion)
169	Dolphin (V-7)	1930	536			3000	20,025	250	70
171	Cuttlerfish (V-9)	1931	414	4	30	3000	14,545	250	74
174	Shark	1933	500	4	38	3000	18,742	250	70
176	Perch	1934	500	4	38	3000	18,946	250	68
182	Salmon	1935	535	4	38	3000	21,060	250	66
188	Sargo	1936	456	5	36	3000	16,096	250	74
194	Seadragon	1937	456			3000	17,210	250	69
198	Tambor	1938	530	5	40	3000	21,574	250	63
204	Mackerel	1939	250	3	24	3000	9,078	250	71
212	Gato	1940	555	5	42	3000	22,044	300	55
231	Bugara	1942	563	5	36	3000	21,822	400	41
435	Corsair	1943	563	5	36	3000	20,193	400	44
564	Trigger	1948	702	6	55	3000	16,735	700	36
571	Nautilus	1952	675	6	53	b(1)	22,307	700	26
575	Seawolf	1953	692	6	53		21,786	700	28
576	Darter	1954	763	6	51		18,364	700	36
578	Skate	1955	506	4	55		11,711	700	37
585	Skipjack	1956	612	4	42		16,503	700	32

EXH 153-2

TABLE 3 (Cont'd)

Unclassified

Hull No.	1 Ship Name	2 Design Year	3 H.P. Air Flask Cap. Cu.Ft.	4 No. Air Banks	5 No. Air Flasks	6 H.P. Air Press.	7 Water and Fuel Ballast Tank Cap. Cu.Ft.	8 Design Depth Ft.	9 % Water and Fuel Ballast Tanks Cap. Blown by H.P. Air at Design Depth (Isothermal Expansion)
586	Triton	1956	2003	6	128	b(1)	67,435	700	26
593	Thresher	1958	405	4	21		20,908	(b) (1)	13
597	Tullibee	1958	334	4	34		11,757		25
598	G. Washington	1958	1203	5	76		28,801		36
608	E. Allen	1959	913	4	44		34,057		18
616	Lafayette	1960	914	4	47		34,096		18

EXH 153-3

EXH 153-3



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO  
C-4790  
Ser 634B-01  
24 April 1963

Unclassified

TRAVEL REPORT

Subj: Review of welding and inspection on SS(N)593 during PSA

Person making visit: Harrison S. Sayre, GS-14, Code 634B

<u>Date</u>	<u>Place Visited</u>	<u>Persons Consulted</u>
15 - 17 April 1963	Portsmouth Naval Shipyard	Capt. J.B. Guerry Jr., Prod. Officer Capt. W.E. Heronemus, Shipbuilding Repair Superintendent Cdr. S. Rule, Production Engineer F.J. Ciolek, Quality Assurance G. Adams, Weld. Engineer B. Bragdon, Quality Assurance G. Gray, Inspector G.W. Marston, U/T Superintendent E. Magoon, Radiographic Inspector

1. Purpose. This visit was made at the request of Code 525 to review the following items with regard to work done on the USS THRESHER during the PSA:

- Salt water piping
- H.P. air and hydraulic piping
- Fuel oil and compensating lines
- Hull closures

2. Background. Code 525 requested that the review be made on the above piping systems and hull closure welds to provide information on the condition of the SS(N)593 following the PSA.

3. Brief. The shipyard welding and inspection personnel were consulted and records of work done during the PSA were reviewed. The following is a summary of findings:

- Hull closures - The hull closures were reported as welded and radiographed in accordance with NAVSHIPS 250-637-3. However, records indicate the 7 day waiting period for inspection was waived and a 48 hour period used on 5 closure patches. The radiographs were satisfactory from a technique standpoint, However, four radiographs showed what was considered to be rejectable defects. Circularity checks were made on the closures.

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Ser 634B-01  
24 April 1963

b. Seawater systems - In accordance with Bureau Code 525 directive an ultra-sonic inspection survey was made on 145 sil-brazed joints out of the reported 3326 brazed joints 2" or over in hazardous systems. Of these joints 20 were rejected on the basis of a 40% acceptance standard. This represents a 4.3% sampling with a 13.79% rejection rate. In the repair of rejected joints 67 new joints were installed 5 of which were welded. On the basis of this U/T survey there could have been approximately 440 joints not inspected but having an indicated bond of less than 40% and on the basis of inherent errors of the inspection process this bond could have been 30% or less.

c. Welded systems - 57 welded joints were made during the PSA. All radiographs except 1 plug weld were reviewed and considered acceptable from a radiographic technique and weld quality standpoint. Severe thinning of the pipe wall thickness by grinding of the weld surface or removal at the backing ring was noticed in a number of joints.

A check to determine whether welded joints were used between the hull and inboard flange of the back-up valve was made. A number of silver brazed joints were found and the shipyard did not believe that all welded joints were required.

d. Fuel oil and compensating lines - These systems are made up entirely of silver brazed joints. During original construction these lines were visually inspected and hydrostatically tested. During PSA the system was hydrostatically tested. An air sealing test showed 6 leaking joints which were repaired.

e. Hydraulic lines - No brazed joints were made in these lines. The system was broken at mechanical joints for replacement of the cellulose by hydraulic oil.

4. Action. Although this visit was primarily for fact finding for Code 525 information on the following action is recommended on the basis of the data given herein:

a. All silver brazed joints in hazardous systems on submarines now under construction or in service should be subject to ultra sonic inspection.

b. ~~The~~ acceptance-rejection criteria of 60% alloy bond should be required unless the inspection activity can assure that the accuracy of the inspection is ~~60%~~ than ~~+~~ - 10% in which case a 50% alloy bond criteria may be used subject to specific Bureau approval.

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c. All rejected joints shall be repaired or replaced.

d. In order to eliminate the inherent error incurred in visual application and reading of the ultra sonic scope indications, the development and use of automatic recording methods for ultra sonic inspection should be expedited.

5. Detailed Discussion. The following is a summary of the findings of the review.

a. Hull Welds - During the PSA six hull closure patches were reported as made. ~~These~~ closures were made as follows:

- #2 Puffs Ant. Removal
- Fr 85 Star Circularity
- Frs 37-38 Trash Ejector
- Frs 95-96 Eng. Room Access Patch
- Fr 56-57 Reactor Compartment Patch
- Fr 80-81 Engine Room Access Patch

The welds were reported by the Shipyard Welding Engineer as being made in accordance with the requirements of NAVSHIPS 250-637-3 with the exception of waivers on required 7 day waiting period for inspection. Code 303 waiver records indicated that use of a 48 hour minimum waiting period was approved for the following:

- 1. Fwd patch outside pressure hull
- 2. Engine room patch Frs 96-97
- 3. Trash Ejector
- 4. Puffs hydrophone patch - defects in the butt adjacent to the patch were waived.
- 5. Main coolant pump patch Fr 57-58

A summary of the hull radiographs is given as Enclosure (1). The radiographs for all closure welds were reviewed. The radiographs were technically of good quality, however, the following defect indications were noted which are considered in excess of acceptance standards of NAVSHIPS 250-637-3:

- T-4 Pos 2-3 and 3-4 large slag with possible tails
- T-10 Pos 4-5 Transverse crack indication
- T-22 Pos 0-1 Borderline slag, small crack indication
- T-21 Pos 1 1/2" long slag.

DOWNING  
DECISION

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Ser 634B-01  
24 April 1963

Circularity checks were made before and after welding of the hull closures. The circularity was checked before welding and templates were prepared. These templates were used to check the circularity after welding the closure patches. Copies of the Portsmouth Naval Shipyard circularity check records are given in Enclosure (2).

b. Piping.

(1) Seawater systems - BuShips ltr SS(N)593 C1/593 Ser 525-0232 of 28 Aug 1962 authorized visual and ultrasonic inspection of the seawater systems silver brazed joints. This was covered by Portsmouth Job Order 15-930-90393, Enclosure (3). A summary of the inspection accomplished is given below.

<u>Plan</u>	<u>System</u>	<u>Joints Accepted</u> <u>U/T Insp.</u>	<u>XX</u> <u>Visual</u> <u>Insp.</u>	<u>Joints Rejected</u> <u>By U/T</u>	<u>New Joints</u> <u>Installed</u>
1862606	ASW Fwd	12	8	1	22
1862775	T & D	14	0	3	6 <sup>5</sup>
1862776	T & D	17	0	4	11
1862780	T & D	21	0	2	5
1862782	T & D	28	11	4	10
1862892	8000 GPD still	33	26	6	13
	Totals	125	45	20	67

\*5 of these replaced joints were changed to welded joints *since welded joints were indicated on plans*

\*\*Joints listed as visually inspected were found satisfactory according to NAVSHIPS 250-648-8. (An attempt to ultrasonically inspect these joints was unsuccessful due to inaccessibility at the joints). A review of the summary sheets for the joints ultrasonically inspected furnished a record of 263 U/T inspections made on the original, repair and replacement joints and the following bond percentages were noted - Below 40% - 40 joints; 40% to 50% - 23 joints; 50% to 60% - 51 joints; 60% or over - 49 joints. The authorization letter established an acceptance criteria of 40% total average bond with not less than 25% bond on either land. In these, bonds in rejected joints as low as 15.5, 10, 8, 7, 5 and 4.5% were noted in original and repair joints.

Shipyard records indicated that there are 3326 brazed joints 2" and over in the hazardous systems as defined by NAVSHIPS 250-648-8. This includes seawater, hydraulic and H.P. air systems. On the basis of the 145 joints U/T inspected this represents a survey of only 4.3% of the brazed joints in the hazardous systems and a rejection rate of 13.79% using the 40% acceptance criteria noted above. The current U/T acceptance standard as specified in NAVSHIPS 329-0029 was established at 60% on the basis of E.B. Div. development work on ultra sonic testing indicating an approximate  $\pm$  - 17% inherent error in use of the U/T procedure.

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Ser 634B-01  
24 April 1963

Discussion with shipyard inspection personnel revealed that they considered the U/T procedure as applied at the shipyard to have an approximate  $\pm$  10% error although no shipyard tests have been made to determine what accuracy of testing is actually being obtained. It was reported that the U/T surveys was done primarily by two qualified teams. Discussions with the U/T inspection personnel indicated that they were following the basic requirements of NAVSHIPS 329-0029. However, the human element entering into the reading of the scope traces and estimating the percent bonding inherently creates an appreciable error in the inspection.

On the basis of the survey made it is indicated that in the balance of the joints not ultrasonically inspected there could have been approximately 440 joints having an indicated bond of less than 40% and on the basis of the inherent errors of the inspection process this bond could have been as low as 30% or less.

(2) Welded systems - During the PSA a total of 57 welded joints were made and radiographically inspected. All radiographs were reviewed and 56 radiographs were considered acceptable from a radiographic technique and weld quality standpoint. One joint in the Auxiliary Steam System consisted of a plug in the end of a  $1\frac{1}{2}$ " pipe and the radiograph was not considered suitable for interpretation. It was noted that in a number of instances the pipe walls had been appreciably thinned by grinding of the weld surface or removal of the backing ring.

A check was made to determine whether all seawater piping was welded between the hull and inboard flange of the backup valve. Code 525 understood that this had been accomplished prior to completion of the submarine. Plan 1862776 shows one sil-braze flange, FL-2 on tank side of hull valve TD 21 and five sil-braze fittings between hull valve TD 21 and Back-up valves TD 19 and TD 20. Plan 1862782 shows welded fittings in drain pump suction line, P-54. A visual inspection by the shipyard of P-54 from strainer, FTD-1 to the suction side of drain pump had revealed these fittings to be sil-brazed. A copy of Portsmouth's internal memorandum on the use of welded pipe joints is given as enclosure (4).

(3) Fuel oil and compensating lines - It was reported by the shipyard that all joints in these lines were made using silver brazed insert type fittings. The maximum size piping was 2". During original construction these lines were visually inspected and hydrostatically tested. During PSA only hydrostatic tests were made of these systems.

Unclassified

Unclassified

C-4790  
Ser 634B-01  
24 April 1963

An air sealing test on MBT 3A, prior to undocking revealed 4 sil-brazed joints in fuel oil filling line P-39, Plan 1862805, and 2 sil-brazed joints in L.O. filling line P-1, Plan 1362638, were leaking. These six joints were replaced, then ultrasonically and hydrostatically tested. No work other than the above repair was done on these lines and no J.O.'s were issued.

(4) Hydraulic lines - The only change in the hydraulic lines was a shift from cellulube to hydraulic oil. The system was reported as opened only at mechanical joints. The largest size piping is 2" in the hydraulic mains. All joints in the HP air and hydraulic piping are brazed. No welded joints were made. The Portsmouth U/T survey did not include the hydraulic or HP air systems. During April-May 1962, Electric Boat Division reportedly surveyed 115 joints in the external hydraulic lines of which 2 were rejected and repairs made.

(b) (6)

Copy to:

634  
648  
640  
630  
525  
1500

SAYRE, 64224/B.R.Harrison, 4/24/63

Unclassified

Unclassified

HULL RADIOGRAPHY

T-1 Insert Aux Seawater Fr 47-48 Stbd mid ship  
 T-2 Insert Hull 12" dia Fr 46-47  
 T-3 Fr Butt  
 T-4 Inner Hull Patch Fr 66-67  
 T-5 Fr Web to Inner Hull #5MBT Fr 66-67  
 T-6 Fr Butt In way of Trash Ejector Fr 37-38  
 T-7 Seam Neg. Tank Fr 32-33  
 T-8 Bulkhead Patch 10" Fwd Trim Fr 14 Stbd  
 T-9 #1 Impulse Tank inboard Blkhd to #3 Portable Water Tank Fr 35-36  
 T-10 Trash Ejector Insert-Midship Fr 37-38  
 T-11 Plug Welds (2) Eng. Rm. Patch Dockside  
 T-12 Patch 10" Blkhd 14 Fwd Trim Tank Fr 14  
 T-13 Bulkhead Patch 10" Fwd Trim, Port Fr 14  
 T-14 Repair weld of T-1  
 T-15 Patch 20" Tank Top Aux #1 Fr 46-48  
 T-16 Fr Web Patch Top CL Midship Fr 44-45  
 T-17 Patch 20" Aux #2 Tank Top Fr 47-48  
 T-18 Patch 20" Aft Trim Tank Top Eng. Rm. Fr 102  
 T-19 Patch 10" Fr 65-66  
 T-20 Patch 10" Fr 22-23  
 T-21 Insert at Fr 65-66  
 T-22 Patch 16" Eng. Rm. Stbd Fr 85-56  
 T-23 Frame and Webs Fr 85  
 T-24 Seam Weld - Top Inbd of Trash Ejector  
 T-25 Clad Weld of Pits Aux 1, Fr 47-48  
 T-26 Clad Weld of Pits Aux 1, Fr 46-47, 47-48, 49-50, 50-51  
 T-27 Patch 20" Fr 51-52  
 T-28 Patch 18' Fr 94-97 Eng Rm  
 T-29 Patch 12' Fr 44-45  
 T-30 Patch 4" off old weld Fr 85  
 T-31 Fr. Butts & Webs, Fr 95-96  
 T-32 Fr. Butts, Fr. 95-96, Eng. Rm Top  
 T-33 Reactor Patch Fr 55-56  
 T-34 Eng. Rm Patch Fr 86-87

Unclassified

Encl: (1) to BuShips Ser 634B-01/C-4790



Exhibit (154) - 7

CONDITION REPORT (SPECS.) File No.  
IND-PNS-1018 (Rev 2-56)

REPORT PNS-4850-29

SERIAL NO. 11-593-19

SHEET NO. 1 OF

SHIP <b>THRESHER 593</b>		DS ORDER <b>15-930-90329</b>		EQUIPMENT <b>ENG. RM. ACCESS PATCH</b>	
CLASS OF SHIP					
OPENING DATE		CLOSING DATE		SERIAL	
(b) (6)		Code 303B3		CLASSIFICATION	
(b) (6) 11-16340		ANALYST		DATA - PDN (See References)	
(b) (6)		DATE 2/20/63		PREPARED BY (b) (6)	
CHECKED BY OTHER		DATE		DATE 2/26/63	
APPROVED BY		DATE		DATE	
REFERENCES					

Circularity readings of Hull at Fr. 80 & 81, readings taken 17" Fwd Fr. 81 - 16" outboard Port & Stbd beyond expanse of patch. Deviation 1/16" or less in any area of circularity readings taken. Template in 593 Field Office.

COPIES TO  
☒ CODE 330  
☒ C.O. VESSEL  
☒ SHIP FILE (2)

ENCL(2)

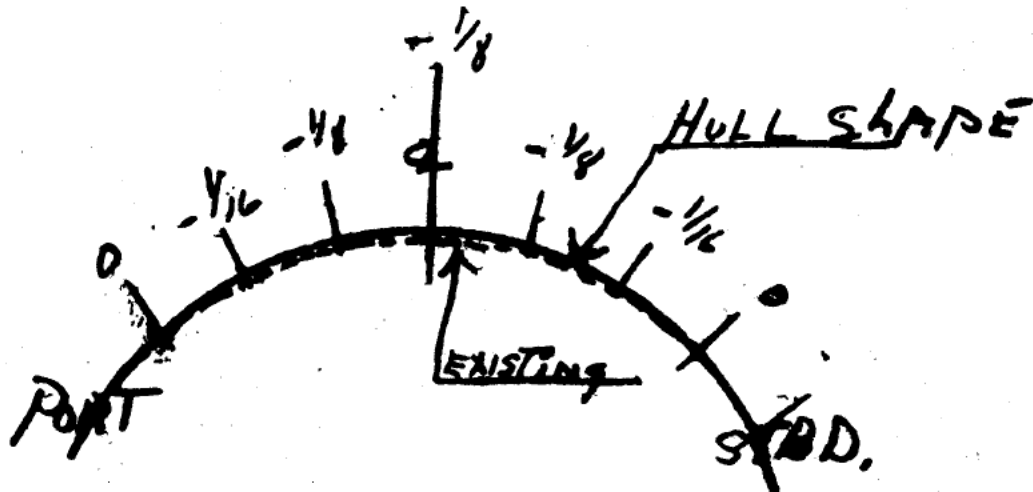
Exhibit (154) - 8

SERIAL NO.

11-593-21

SHEET NO. 1 OF

SHIP 593	JOB ORDER 15-930-90309	EQUIPMENT ENG RM ACCESS ATE 1	FR. 80-81
CLASS OF SHIP	OPENING DATE	CLOSING DATE	SERIAL
VI (b) (6)	Code 303	CLASSIFICATION	UNIT NO.
MECH (b) (6)	ANALYST	DATA FROM (See References)	
(b) (6)	DATE 2-25-63	PREPARED BY	DATE
CHECK (b) (6)	DATE 2/25	APPROVED BY	DATE
REFERENCES			



CIRCULARITY READINGS OF HULL AT 15"  
AFT OF FR. 80

COPIES TO: 119

☐ CODE 300 (3)

☒ CODE 330

☐ C.O. VESSEL

☒ SHIP FILE (2)

ENCL (2)

CONDITION REPORT (SPECS.) File No.  
100-PNS-1010 (Rev 2-56)

REPORT PNS-4850-28

ev SERIAL NO. 11-593-2 SHEET NO. 1 OF 1

SHIP <b>3 9 3</b>	JOB ORDER <b>15 930 52203</b>	EQUIPMENT <b>#2 PUFFS ANT. REMOVAL</b>	
CLASS OF SHIP			
OPENING DATE	CLOSING DATE	SERIAL	UNIT NO.
(b) (6) Code 303B-3		CLASSIFICATION	
MECHANIC (b) (6)	ANALYST	DATE FROM (For References)	
CHECKED BY LHM. (b) (6)	DATE 8-2-62	PREPARED BY H. A. Davis	DATE 8-2-62
CHECKED BY SPIN. (b) (6)	DATE 8-2-62	APPROVED BY	DATE
REFERENCES P1-1862316 Alt "D"			

(2) Readings taken in area of Puffs Hydrophone Hull Patch.

1 - 3" FWD of cut at Frame 45

1 - 3" AFT " " " " 46

Deviation 1/16" or less in any of the above areas.

N O T E --- TEMPLATES IN POSSESSION OF SHOP 11.

COPIES TO:  
☐ CODE 230 (3) 
 ☐ CODE 330 
 ☐ C.O. VESSEL 
 ☐ SHOP FILE (2)

Navy-DPPD IND. Portsmouth, N.H.

Encl (2)

Exhibit (154) - 10

CONDITION REPORT (SPECS.)

File No. 11-593-20

REPORT PWS-4050-28

SERIAL NO.

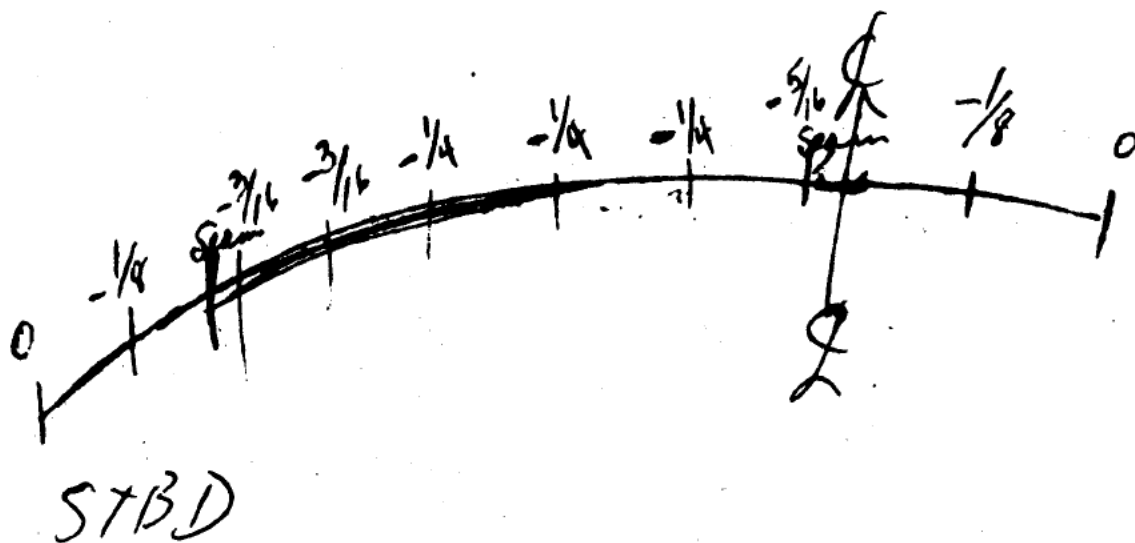
11-593-20

SHEET NO. 1 OF

SHIP <u>593</u>	JOB ORDER	EQUIPMENT	
CLASS OF SHIP			
OPENING DATE <u>2/22/63</u> (b) (6)	CLOSING DATE	SERIAL	UNIT NO.
		CLASSIFICATION	
MECHANIC <u>(b) (6)</u>	ANALYST <u>(b) (6)</u>	DATA FROM (See References)	
DATE <u>2-22-63</u>	PREPARED BY	DATE	
DATE <u>2/22/63</u>	APPROVED BY	DATE	

REFERENCES

Circularity - Patch old #2 Puffs area.  
DM-252A-142-62  
Taken at FR 45 1/2



COPIES TO: 11

☐ CODE 300 (3)

☒ CODE 330

☐ C.O. VESSEL

☒ SHOP FILE (3)

ENCL (2)

INSPECTION REPORT (SPS-26) File No.  
 INS-100-1010 (Rev. 2-56)

REPORT PWS-4830-28

SHIP <b>593</b>		SERIAL NO. <b>11-593-14</b>		SHEET NO. 1 OF <b>1</b>	
JOB ORDER <b>15-930-20813</b>		CONTAINER <b>HULL PATCH FR-85 STAR CIRCULARITY</b>			
CLASS OF SHIP					
DESIGN DATE	CLASSIFY DATE	DATE	UNIT NO.		
OFFERED BY <b>(b) (6) 303-B</b>		CLASSIFICATION <b>INSPECTION 303-B</b>			
REFERENCE <b>(b) (6) 11-3546</b>	ANALYST	DATA FROM (See References)			
ORDERED BY LIAISON <b>(b) (6)</b>	DATE <b>12-26-62</b>	PREPARED BY <b>(b) (6)</b>	DATE <b>12-26-62</b>		
ORDERED BY OTHER	DATE <b>12-27-62</b>	APPROVED BY <b>(b) (6)</b>	DATE		
REMARKS <b>DM 252A-196-62</b>					

Readings taken by X-11 and witnessed by Code 303-B are less than 1/8" deviation in any area.

Readings taken at 1-1/2" Fwd of FR-85 and 12" Fwd of 86.

Template stowed at X-11 Field Office, Dry Dock #2.

<input type="checkbox"/> CODE 200	<input type="checkbox"/> C.O. VESSEL	<input checked="" type="checkbox"/> SHIP FILE	Code 340
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*Encl (2)*

COMBINATION REPORT (SPECS.) File No.  
 15-930-1018 (Rev 8-56)

REPORT PHS-4880-20

eav		SERIAL NO. 11-593-15		SHEET NO. 1 OF 1	
SHIP 5 9 3		JOB ORDER 15-930-60902		EQUIPMENT TRASH EJECTOR PATCH CIRCULARITY	
NAME OF SHIP					
SPECS. DATE		CLOSING DATE		SERIAL	
WITNESSED BY DUBE 303-B		CLASSIFICATION INSPECTOR 303-B			
MECHANIC		ANALYST		DATA FROM (See References)	
CHECKED BY LHM. (b) (6)		DATE 12-26-62		PREPARED BY (b) (6)	
CHECKED BY CDM.		DATE 12-26-62		DATE 12-26-62	
APPROVED BY (b) (6)		DATE			
REFERENCES 1863577 WT MK 112/1 FR 37-38 STBD					

Readings taken by X-11 and witnessed by Code 303-B are less than 1/8" deviation in any area.

Templates stowed at X-11 Field Office Dry Dock #2.

<input checked="" type="checkbox"/> CODE 300	<input type="checkbox"/> CODE 300	<input type="checkbox"/> C.O. VESSEL	<input checked="" type="checkbox"/> SHOP FILE	Code 340
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Exhibit (154) -

ENCL (2)

COMPLIANCE REPORT (SPECS.) FILE  
14-720-1010 (See 2-56)

REPORT PMS-4890-20

eav		SERIAL NO. 11-593-18		SHEET NO. 1 OF 1	
SHIP THRESHER (593)		JOB ORDER 15-930-60902		EQUIPMENT RS TRASH EJECTOR FRS 37 - 38	
CLASS OF SHIP					
STARTING DATE		CLOSING DATE		SERIAL	
				UNIT NO.	
DIVISION BY (b) (6)		303-B3		CLASSIFICATION	
RECORDING (b) (6)		ANALYST Shipfitter		DATA FROM (See References)	
CHECKED BY LHM (b) (6)		41 Code		DATE 9-14-62	
CHECKED BY OTHER (b) (6)		DATE		APPROVED BY (b) (6)	
				DATE 9-14-62	
REFERENCES					

CIRCULARITY READINGS TAKEN AT FRS 37 - 38 PRIOR TO REMOVAL OF TRASH EJECTOR FOR REPLACEMENT.

2" Pitch P1-1863577-E

NO DEVIATION NOTICEABLE IN THE AREAS SCRIBED - TEMPLATES IN POSSESSION OF SHOP 11 IN FIELD OFFICE.

☐ CODE 230 (3)
 ☐ CODE 330
 ☐ C.O. VESSEL
 ☐ SHOP FILE

CONDITION REPORT (SPEC.) File No.  
1AB-PNS-1018 (Rev 2-66)

REPORT PNS-4850-28

ev

SERIAL NO. 11-593-1

SHEET NO. 1 OF 1

SHIP 5 9 3		JOB ORDER 15 930 90329		EQUIPMENT ENG. RM ACCESS PATCH T-20	
CLASS OF SHIP					
OPENING DATE		CLOSING DATE		SERIAL	
WITNESSED BY (b) (6)		Code 303B-3		CLASSIFICATION	
MECHANIC (b) (6)		ANALYST		DATA FROM (See References)	
CHECKED BY LHM (b) (6)		DATE 8-2-62		PREPARED BY (b) (6)	
CHECKED BY BHM (b) (6)		DATE 8-2-62		DATE 8-2-62	

REFERENCES

Plan - DM252A-136-62

CIRCULARITY READINGS OF HULL AT FRS 95 & 96.

Readings taken at 7" FWD of Frame-95 centerline - Outboard PORT & STBD  
- 10" beyond expanse of Hull Patch and 7" AFT Fr-96 Same expanse  
PORT & STBD.

Deviation 1/16" or less in any area of Circularity Readings taken.

N O T E : TEMPLATES IN POSSESSION OF SHOP 11.

CODE 230 (3)

☐

CODE 330

☐

C.O. VESSEL

☐

SHOP FILE

(2)

Navy-DPPD INB, Portsmouth, N.H.

ENC(2)

Exhibit (154) - 15

CONDITION REPORT (SPECS.) File No.  
1AD-PNS-1018 (Rev 2-56)

7 Copies

REPORT PNS-4850-28

SERIAL NO.

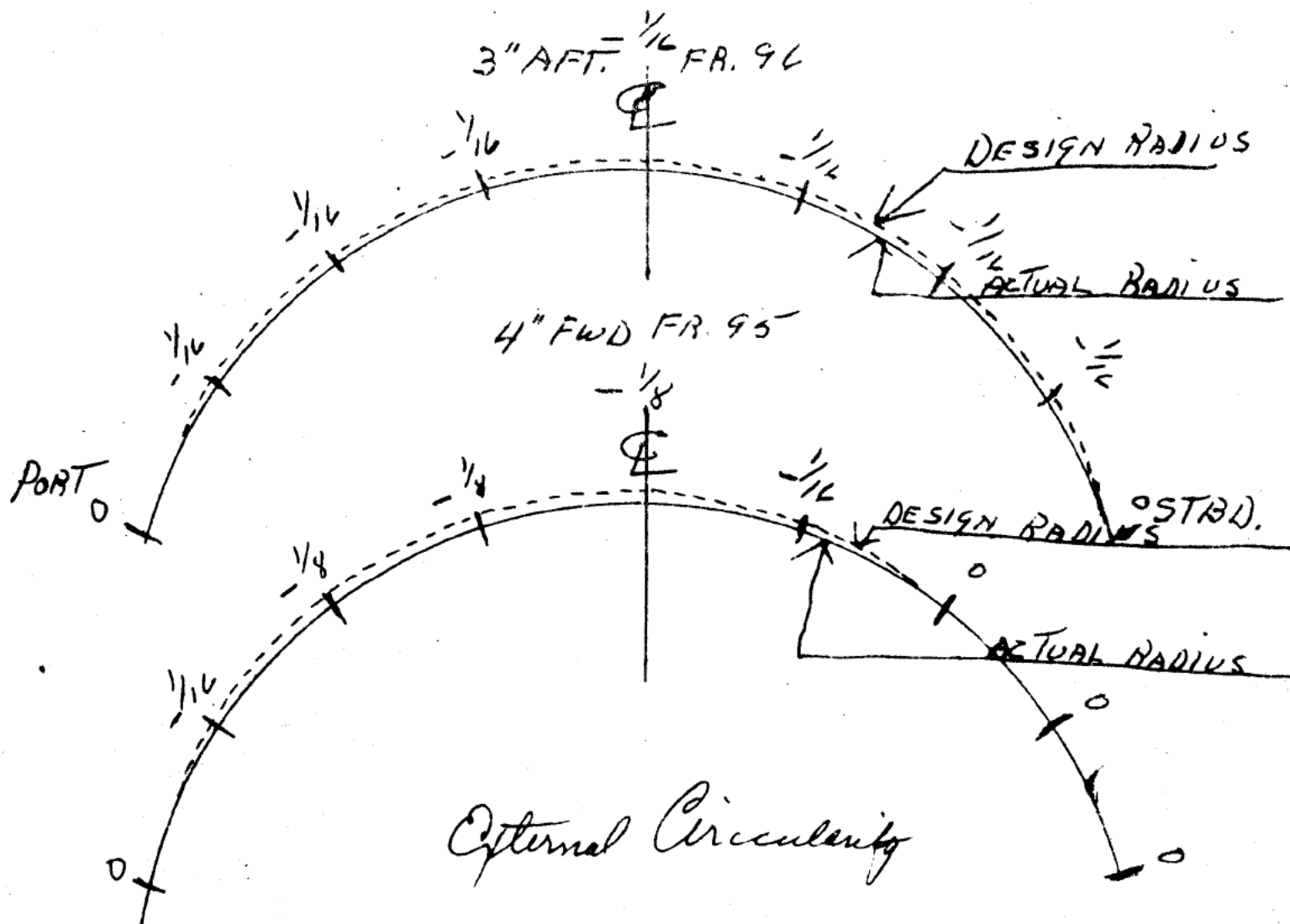
11-593-17

SHEET NO. 1 OF

SHIP <b>593</b>	JOB ORDER	EQUIPMENT	
CLASS OF SHIP			
OPENING DATE	CLOSING DATE	SERIAL	UNIT NO.
WITNESSED BY <b>(b) (6)</b>		CLASSIFICATION	
MECH <b>(b) (6)</b>	ANALYST <b>803 B-3</b>	DATA FROM (See References)	
CI <b>(b) (6)</b>	DATE <b>1/11/63</b>	PREPARED BY	DATE
CHECKED BY QTRM.	DATE	APPROVED BY	DATE

REFERENCES

CIRCULARITY ENGINE RM. PATCH



COPIES TO:  
☐ CODE 230 (3)    ☐ CODE 330    ☐ C.O. VESSEL    ☐ SHOP FILE

Encl(2)

Exhibit (154) - 16

CONDITION REPORT (SPECS.) Form No. 1AD-PMS-1018 (Rev 2-56)

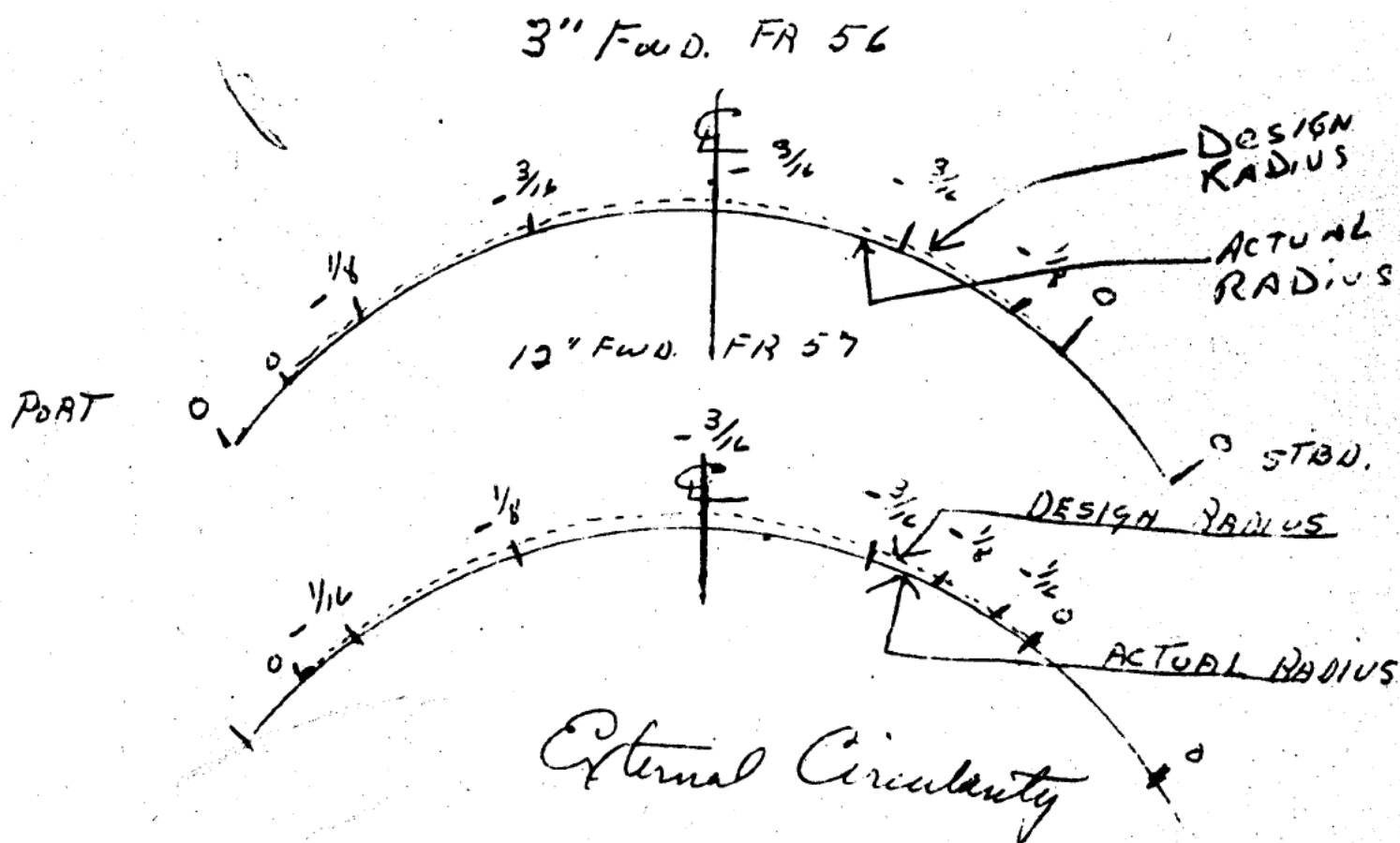
7 Copies

SHIP <b>593</b>		JOB ORDER		SERIAL NO. <b>11-593-16</b>		SHEET <b>1</b>	
CLASS OF SHIP		EQUIPMENT					
OPENING DATE		CLOSING DATE		SERIAL		UNIT NO.	
WITNESSED BY (b) (6)		ANALYST <b>303 R-3</b>		CLASSIFICATION			
(b) (6)		DATE <b>1-11-63</b>		DATA FROM (See References)			
CHE (b) (6)		DATE		PREPARED BY		DATE	
CHE		DATE		APPROVED BY		DATE	

REFERENCES

**CIRCULARITY REACTOR COMP. PATCH**

SCALE 1" = 1'



COPIES TO:

☐ CODE 230 (3) ☐ CODE 330 ☐ C.O. VESSEL ☐ SHOP FILE

ENCL (2)

Exhibit (154) - 17

CONDITION REPORT (SPECS.) File No.  
100-700-1019 (Rev 2-60)

REPORT PMS-4850-20

SERIAL NO. 11-593-3

SHEET NO. 1 OF 1

SY 5 9 3		JOB NO. 15-930-90329		HULL CIRCULARITY AT FRAMES 80 - 81	
CLASS OF SHIP				T-34	
STARTING DATE		ENDING DATE		SHEET NO.	
OBTAINED BY		CLASSIFICATION			
REMARKS (b) (6)		ANALYST		DATA FROM (See References)	
OBTAINED BY LAB. (b) (6) Code 41		DATE 8-24-62		PERFORMED BY (b) (6) Code 41 DATE 8-24-62	
OBTAINED BY OTHER		DATE		APPROVED BY DATE	
REFERENCES DM 252A-136-62					

CIRCULARITY Readings taken 6" Fwd and 6" Aft of FRAMES 80 and 81 prior to cutting access patch at top of hull.

Deviation is less than 1/16" in any of the above areas.

Template in possession of SHOP 11.

☐ CODE 220 (20) ☐ CODE 200 ☐ C.O. VESSEL ☐ SHOP FILE

ENCL(2)

# JOB ORDER

(IND-PMS-1714 (REV. 4-53))

(b) (6)		CODE	R. RANGE	CODE	SHIP ACTIVITY	JOB ORDER NUMBER
177			(b) (6)	280	SS(N) 593	930-90393
DATE SCHEDULED	MOORE	DATE PREPARED	MOORE			
10-19-62	1363	10-17-62	206			

AUTHORITY		P & S SLIP (UNIT CODE DATE)		TYPE DESK (UNIT CODE DATE)	
W/L ITEM N-116		C.A 2B 10 18		JMS 213 10/19/62	

VISUAL & U.T. INSPECTION OF SEA WATER SYS 10-19-62

WORK DESCRIPTION							
KEY OF	KEY SHOP CTS	JOB SHOP CTS	ESTIMATED MAN HOURS	SCHEDULE DATES		REF.	
				ALLOW	TYPE		
						(A) D.L.I. #15263	
						(B) 862776-K (U.S.)	
02	5006	48	A 11-2614/1-762			IN ACCORDANCE WITH REF. (A) REMOVE AND REPLACE THE FOLLOWING FITTINGS SHOWN ON REF (B)	
						F-9-1 & F-9-2 ON P-39	
						F-19-1 ON P-33-1	
						F-7-2 ON P-36-1	
						SOURCE OF NEW FITTINGS WILL BE SS/SB	
			(2)			90° ELLS. (385766) H4730-299-8472	
			(1)			90° ELLS. (385766) H4730-299-8474	
			(1)			TEE-S-1-3 (385766) H4730-542-4366	
NOTE: THIS IS TO COVER REJECTED JOINTS R-1, R-2 R-7 AND R-8							

INDUSTRIAL SUPPLY		ELECTRICAL		MECHANICAL		SERVICE		MILL. FWD.		PLANS SUPPLY & CONTROLLER DEP	
DATE	QTY	DATE	QTY	DATE	QTY	DATE	QTY	DATE	QTY	DATE	QTY
10-19-62	1363	10-17-62	206	10-17-62	206	10-17-62	206	10-17-62	206	10-17-62	206
TOTAL EMPLOYER		DATE		LABOR (DOLLARS)		OVERHEAD (DOLLARS)		MATERIAL (DOLLARS)		TOTAL DOLLARS	
								50.			

IND-PNS-1714 (REV. 4-62)

AUTHORITY	P & E SUPVR. (UNIT CODE DATE)	TYPE DESK (UNIT CODE DATE)
W/L ITEM N-116	CA 2B 11-14	11 213X 11-14-2

VISUAL & ULTRASONIC INSPECTION OF SALT WATER SYSTEM 11-20-62

23 DISTR.	PRODUCTION DEPT.		STRUCT.		OUTFG		ELEC.		MECHANICAL		SERVICE		MACH. PWR.		PLANNING SUPPLY & CONTROLLER DEPT.												
	302C	103D	340	11	17	38	51	66	71	47	64	71	2362	63	2344B	227	228	229	231	232	233	234	213				
	340A	376	377	23	26	56	67	81	94		72	99	2306	86	245A	239	307	608	565	690		251					
WORK COMPLETED			DATE			LABOR (DOLLARS)					OVERHEAD (DOLLARS)					MATERIAL (DOLLARS)					TOTAL (DOLLARS)						

# JOB ORDER

IND-PNS-1714 (REV. 4-82)

AMF FILE NO. (b) (6)	CODE 377D	PLANNER (b) (6)	CODE 280	SHIP ACTIVITY SS(N).593	JOS ORDER NUMBER 15-930-90393
DATE SCHEDULED 16-10-62	PHONE 1363	DATE PREPARED 10-8-62	PHONE 206		

AUTHORITY	P & E SUPERV. (UNIT CODE DATE)	TYPE DESK (UNIT CODE DATE)
W/L ITEM N-116	CD 2B 10-8	CHS 213 4/1/82

208 TITLE  
S.W. SIL-BIRZ INTEGRITY INSPECTION 10-10-6

[illegible]

## IND-PNS-1714 (REV. 4-62)

## JOINT TITLE

KEY OP	KEY SHOP WORK CTR.	ASST SHOP WORK CTR.	ESTIMATED MAN HOURS		SCHEDULE DATES		REF.
			ALLOW	TYPE	START	COMPLETE	
							A.D. 1 #15545 B. 1862606
13	5646		24	A	12-12-62	12-14-62	INSTALL F-7, F-27 & P-7-3 PER REF ALL MATERIAL IS SS 56  F-7 G 4730-289-8470 F-27 G 4730-542-4364 P-7-3 G 4710-542-1915

PRODUCTION DEPT.			STRUCT.		OUTFG.		ELEC.		MECHANICAL			SERVICE		NUCL. PWR.		PLANNING SUPPLY & COMPTROLLER DEP.				
303C	303D	340	11	17	38	51	06	31	37	64	71	2302	83	23448	227	228	229	231	233	233
340A	376	377	23	28	56	87	81	94		72	99	2306	66	2436	238	507	600	563	600	

WORK COMPLETED	DATE	LABOR ( DOLLARS )	OVERHEAD ( DOLLARS )	MATERIAL ( DOLLARS )	TOTAL ( DOLLARS )
				10	10

SHEET / OF /

IND-PNS-1714 (REV. 4-62)

AUTHORITY W L ITEM N 116	P & E SUPVR: (UNIT CODE DATE) CA 2B 11-28	TYPE DESK (UNIT CODE DATE) QMB 213 11/28
JOB TITLE		

WORK DESCRIPTION	
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DISTR.	PRODUCTION DEPT.			STRUCT.	OUTFG	ELEC.	MECHANICAL			SERVICE		NUCL. PWR.	PLANNING SUPPLY & COMPTROLLER DEPT.								
	303C	303D	303E	11	17	38	51	06	31	37	64	71	2302	63	3445	227	220	220	226	229	233
3	340A	378	377	23	28	50	67	81	94		72	99	2306	66	354	230	507	508	509	510	511

SHEET / OF /

# JOB ORDER

ING-PMS-1714 (REV. 4-62)

CHECKER (b) (6)	CODE 5067	PLANNER (b) (6)	CODE 280	SHIP ACTIVITY SS(N) 593	JOB ORDER NUMBER 15-930-90393
DATE SCHEDULED 11/10/62	PHONE 1363	DATE PREPARED 11-14-62	PHONE 206		

AUTHORITY R-17 & R-18 W/L ITEM N-116	P & E SUPERV. (UNIT CODE DATE) C-A 2B 11-14	TYPE CODE (UNIT CODE DATE) JMS 213 11/10/62
-----------------------------------------	------------------------------------------------	------------------------------------------------

JOB TITLE: SW TEST 11-16-62

WORK DESCRIPTION									
KL OP	KEY SHOP WORK CTR	ASST SHOP WORK CTR	ESTIMATED MAN HOURS		SCHEDULE DATES				
			ALLOW	TYPE	START	COMPLETE			
							A. DLI 15408		
							B. 1862892 RA 8000 GPD STILL		
97	3-6		8	A	11-19-62	11-21-62	REPLACE F-5-Y b(3) 10 L		
							FL-2-3 b(3) 10 L		
							FLANGE ON REF.		
							B PER REF A.		

34	PRODUCTION DEPT.	STRUCT.	OUTPS	ELEC.	MECHANICAL	SERVICE	MUCL. PWR.	PLANNING SUPPLY & COMPUTER/REP		
303C	303D	340	11	17	38	51	06	31	37	64
340A	376	377	23	26	39	67	81	94	72	99
2302	63	2340	227	228	229	231	232	233	234	235
2306	66	245A	239	297	298	300	301	302	303	304
LABOR (DOLLARS)	OVERHEAD (DOLLARS)	MATERIAL (DOLLARS)	TOTAL (DOLLARS)							
		20								

# JOB ORDER

IND-PNS-1714 (REV. 4-62)

SCHEDULER	CODE	PLANNER	CODE	SHIP ACTIVITY	JOB ORDER NUMBER
		(b) (6)	28Y	THRESHOLD	15-930-90393
DATE SCHEDULED	PHONE	DATE PREPARED	PHONE		
		11/2/62	206		

AUTHORITY	P & E SUPER. (UNIT CODE DATE)	TYPE DESK (UNIT CODE DATE)
W/L ITBIA N116	CA 2B 11-2	213 11/2/62

JOB TITLE: P.A. 8000 GPD DISTILLERS 11-8-62

WORK DESCRIPTION								
KEY OP	KEY SHOP WORK CTR	ASST SHOP WORK CTR	ESTIMATED MAN HOURS		SCHEDULE DATES		(A) DLI 15346	REF.
			ALLOW	TYPE	START	COMPLETE		
05	5606		24	A	11-1	11-1	REMOVE & REINSTALL F-6-2	A
							& ASSOC FTS OF P 1862892	
							AS PER PMF(A) & SHOP STARK	
							MATERIAL QUOTED THROUGH	
							UT BEFORE INSTN IN RENT.	
06	3110		1	A			INSP & TEST	
	3106		3	A			MACH STRAINING SOCKETS &	
							SILS GRABBS IN RECORD WITH	
							DWE 1885266 (1) F-6-2 2 1/2"	
							Y" TYPE STRAINER	

DISTR.	PRODUCTION DEPT.		STRUCT.	OUTFC	ELEC.	MECHANICAL		SERVICE	NUCL. PWR.	PLANNING SUPPLY & COMPTROLLER DEP											
	303C	303D	340	11	17	38	51	06	31	37	64	71	2302	63	23448	227	220	228	231	232	233
	340A	376	377	23	26	56	67	81	94		72	99	2306	66	245A	239	507	608	565		
99			DATE		LABOR (DOLLARS)		OVERHEAD (DOLLARS)		MATERIAL (DOLLARS)		TOTAL (DOLLARS)										

SHEET 1 OF 1

IND-PNS-1714 (REV. 4-62)

AUTHORITY	P & E SUPVR. (UNIT CODE DATE)	TYPE DESK (UNIT CODE DATE)
W/L ITEM N-116	C.D 2B 10-30	JB 213 4/5/62
JOB TITLE		
T & D SYS - REPLACEMENT OF REQUESTED FITINGS		11-6-62

DIST. 34	PRODUCTION DEPT.			STRUCT.		OUTPS		ELEC.		MECHANICAL			SERVICE		NUCL. PWR.		PLANNING SUPPLY & COMPTROLLER DEP							
	303C	303D	340	11	17	38	51	06	31	37	64	71	2302	63	2344B	227	228	229	231	232	233			
	340A	376	377	23	26	36	67	81	94		72	89	2306	66	245A	239	507	609	563	650	213	557		
WORK COMPLETED				DATE				LABOR (DOLLARS)				OVERHEAD (DOLLARS)				MATERIAL (DOLLARS)				TOTAL (DOLLARS)				
																18.				P				

IND-PNS-1714 (REV. 4-62)

AUTHORITY 40/L ITEM N-116	P & E SUPVR. (UNIT CODE DATE) CPT 213 10-22	TYPE DESK (UNIT CODE DATE) JPT 213 10-22
JOB TITLE		

JOB TITLE  
TED SYS - REPLACEMENT OF DEFECTED FITTINGS

PROTECTION DEPT.				STEEL	PIPE	ELEC.	MECHANICAL			SERVICE		NUCL. PWR.		FLAMING SUPPLY & CONTROLLER DEP.											
DATE	2025	2025	2025	10	17	20	21	08	21	27	64	71	2302	63	23440	227	220	220	221	222	223				
23	2025	2025	2025	22	26	30	67	01	04		72	99	2306	66	243A	239	507	600	505	550					
HOURS REPORTED				DAYS			LABOR (DOLLARS)					OVERHEAD (DOLLARS)			MATERIAL (DOLLARS)			TOTAL (DOLLARS)							
															35.			1013 1251							

**SHEET**

UNITED STATES GOVERNMENT

# Memorandum

TO : 310

DATE: 4-16-63

FROM : 316

SUBJECT: Specifications, 593 Class, use of welded pipe joints in sea water systems, Preliminary Report.

1. Specifications do not specify use of welded joints in sea water systems. Following extracts are pertinent:

a. S 21-1 p 250

External Hydraulics - "All piping connections located outside the pressure hull shall be welded and in accordance with S 21-1 F."

b. S 48-0 P 472

"Welded joints shall be used in carbon steel and alloy steel or other weldable piping to the maximum extent practicable."

2. Change order 163, cat A, dated 3-24-61

a. S 48-0, p 457, ~~###~~

ENCL(4)

CO #163 Cat A 3-24-61

a. 548-0 p457 Add

“ Joints in piping between backup valves and sea valves in all sea water system in sizes above <sup>b(3) 10 USC 130</sup> shall be welded, where joints have not been installed. Joints in sizes above <sup>b(3) 10 USC 130</sup> that are located inboard of backup valves in the main, auxiliary, and air conditioning sea water systems shall be welded, where joints have not been installed. For take down joints, this included only pipe connections to flanges and unions.”

b.(1) 59-1 p 114

Lines 86-88, delete “used . . . involved” and substitute “in accordance with standards

250-637-2.” (Has to do with use of preinserted soldering)

(2) Lines 89-90, delete “All welded . . . piping.” and substitute

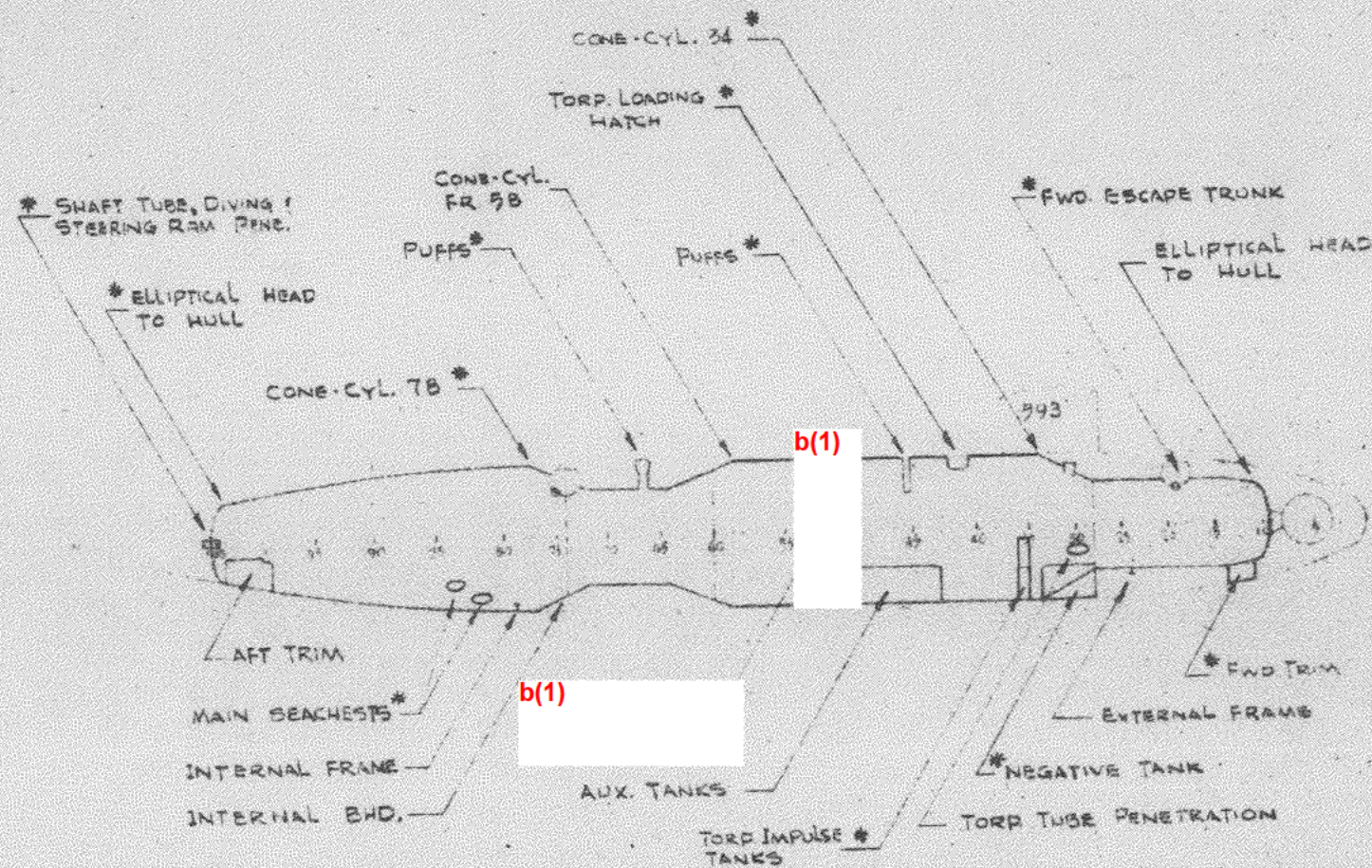
<sup>fractureographic</sup>  
(Visual inspection of Sile jts per PTSMH Booklet)

3. In view of date of Change order 163 it seems unlikely that any changes to 593 piping were made as a result of the Change order. Last paragraph of CO states in part "It is not intended that this change result in rework of satisfactorily completed joints prepared in accordance with previous instructions."

4. Am continuing review of other change orders and implementing work instructions.

Very respectfully

(b) (6)



\* ITEMS REVEALING  
DEFECTS DURING  
LAST INSPECTION

SS(N)593 HULL SURVEILLANCE INSPECTION

64155

DLV

Unclassified

*K*  
From: Commander, Portsmouth Naval Shipyard  
To: Chief, Bureau of Ships

Subj: Pipe-joint inspection USS THRESHER (SS(N)593)

1. It is considered by this Shipyard that no additional pipe-joint inspection is required for USS THRESHER (SS(N)593) during PSA other than that which results from damage incurred during shock testing. All piping systems have been thoroughly inspected previously, and further inspection would be redundant.

2. Bureau concurrence is requested.

b(6)

Copy to:  
COMUSBLANT  
DEPCOMUSBLANT

*210 2 cpy*

Unclassified

*Exhibit (156)*

FILE

Checked by

213  
SS(N)593/9480  
Ser 0114-62

MAY -8 1982

MAILED

Let. *CV*

Incls.

FILED



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

SS(N)593/9480  
Ser 525-1325

From: Chief, Bureau of Ships  
To: Commander, Portsmouth Naval Shipyard

29 MAY 1962

Subj: Piping Joint Inspection, USS THRESHER (SS(N)593)

Ref: (a) NAVSHIPYD PTSMH conf ltr ser 0114-62 of 9 May 62  
(b) BUSHIPS ltr ser 648X-160 of 13 Feb 62 70107  
(c) NAVSHIPS 250-648-8

1. The Bureau concurs only in part with reference (a) but not for the reasons listed therein.

2. The results of U/T of hydraulic piping in THRESHER during pre-shock test availability indicated irregularities in 8 out of 115 joints tested. Two joints had a total bonded area of less than 40% and were cut out and replaced with sound sil-brazed fittings. The remaining 6 joints showed a total bonded area in excess of 40% but gave evidence of no bond on the inner land. This is characteristic of an insert type fitting which has been installed without pre-inserted silver solder ring and has been bonded by face feeding. In view of these findings the Bureau cannot agree with the statement that further testing is redundant.

*See Water only*  
3. In accordance with enclosure (1) of reference (b) the visual inspection of sub paragraph 1a and the certification of sub paragraph 1d are required during THRESHER PSA. The ultrasonic testing and X-ray listed in enclosure (1) of reference (b) does not apply to THRESHER since applicable piping joints between hull and back-up valves are of welded construction. Systems should be repaired and completed systems tested as indicated in reference (b).

4. Action on the remaining six joints containing irregularities will be deferred pending study of the results of tests being conducted currently. A final report of these tests is due in the Bureau by 1 June 1962. Joints having a bonded area in excess of 40% appear to be satisfactory from aspects of shock and static strength. If the fatigue properties appear to be as favorable as shock and static strength characteristics these joints will be retained. If the fatigue characteristics are not adequate NAVSHIPYD PTSMH will be instructed to cut out and replace these joints. A definite course of action will be transmitted to NAVSHIPYD PTSMH prior to the commencement of THRESHER PSA.

b(6)

Copy to:  
COMSUBLANT  
DEPCOMSUBLANT  
COMSUBPAC  
USS THRESHER (SS(N)593)

Exhibit (157)



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO  
9480  
Ser 648X-160  
13 Feb 1962

From: Chief, Bureau of Ships  
To: Distribution List

Subj: Silver Brazed Sea Water Systems, Procedures  
During Overhauls on Submarines

Ref: (a) DEPCOMSUBLANT 131410Z Sep *Not on file 865*  
(b) BUSHIPS 152242Z Sep " " " "  
(c) NAVSHIPS 250-637-2; NAVSHIPS 250-648-8  
(d) BUSHIPS INST. 9480.53 of 28 May 1961 67326  
(Face Feed Fittings)  
(e) BUSHIPS INST. 4410.17 of 22 June 1961 66334  
(Material Identification)

Encl: (1) Procedures During Overhauls or Availabilities  
(2) Listing of Applicable Submarines  
(3) Representative Data from Portsmouth Report  
of 1 March 1961  
(4) Data from E.E.S. Report 920032 of 6 Nov 1961

1. Reference (a) detailed the seriousness with which Deputy Commander Submarine Force, U.S. Atlantic Fleet viewed the failures of various components of the piping systems on submarines. Reference (b) concurred in the seriousness of the problem and outlined a series of actions underway to insure that future ships would be free of these troubles to the maximum extent possible. This letter is concerned specifically with the area of silver brazed sea water systems and includes in enclosure (1) recommendations for actions to be undertaken during regular overhauls and post shakedown availabilities relative to these systems. Enclosure (2) contains a list of submarines to which this letter applies.

2. In analyzing the failures it became apparent that they resulted from either gross procedural errors or the use of wrong materials. Corrective actions, including instructions, etc., have been taken for each of these causes as follows:

a. Procedural errors:

9480 70107

9480  
Ser 648X-160

1. "Instructions for torch brazings of ferrous and non-ferrous piping", NAVSHIPS 250-637-2 has been revised, and re-issued dated July 1961. The most important procedural changes made were:

- A. Discontinued use of face feed fittings on sea connected systems above 1/2". Reference (d).
- B. Established and emphasized proper fitting and sizing standards.
- C. Set positive control of priming.
- D. Set positive control on repairs and supplemental face feeding.
- E. Required radiographs of all field made joints above 2".

2. NAVSHIPS 250-648-8, Inspection and Test of Silver Brazed Systems, has been issued.

3. Change orders have been issued invoking the above changes on new construction ships.

b. Wrong Materials:

- 1. Reference (e) has been issued.
- 2. Bureau audited procedures in 17 yards and this will be repeated as necessary.
- 3. Shipyard Commanders and Supervisors of Shipbuilding have examined quality control procedures and have upgraded them to insure use of proper material.
- 4. Positive identification of materials after installation is being added to all new contracts.
- 5. Joints are identified to brazer making joint.
- 6. These steps are combined with a continued emphasis and an awareness of top management of the problem and consequences of failures to provide such quality assurance.

9480  
Ser 648X-160

3. Enclosures (3) and (4) represent a tabulation of available data relating strength of a joint to percent bond. They show that with a relatively small percent bond the joint is basically stronger than the parent metal and will not fail by a catastrophic pull out. Additional test will be run to ascertain more on these facets of the problem but sufficient work has been done to allow establishment of bond strength criteria. Procedures covered in paragraph 2(a) above have been shown to give sufficient bond to insure reliability of the joint.

4. Non-destructive testing techniques have been under constant study. In addition to radiography, ultrasonics has been developed to a point where it can be used. This is a very valuable tool which has been developed and is used at both Mare Island Naval Shipyard and Electric Boat Division of General Dynamics Corp. This technique has been shown to be generally a fail safe device i.e. a bad point is not passed but an occasional good joint may be rejected. Sufficient data is available to authorize it's use in lieu of radiography for specific cases. This technique is being developed by submarine yards and builders for use in this application.

5. In addition to the above action 3 ships of the SS(N)593 class in the FY62 program have been awarded with a requirement for all welded sea water systems 1" and above. This requirement will give an opportunity to evaluate the gain in dependability and equate this against factors of cost and space which are involved in such an installation.

6. All of the above actions have been aimed primarily at new construction and for ships built to these new specifications there exists a high degree of confidence. It is necessary however that certain decisions regarding post shakedown availabilities and regular overhauls be made for the ships which were essentially completed before these changes became effective. Enclosure (1) contains recommendations on these two points and is based on the best technical and practical information currently available. Comments of addressees are invited to insure that time and funds available are used in such a manner to insure the highest possible level of dependability in submarine sea water systems.

(b) (6)

Distribution List:  
See Next Page.

-3-

R. L. MOHAN  
Asst Chief of Bureau  
for Design, Shipbuilding,  
and Fleet Maintenance  
Acting

Exhibit (158) - 3

9480  
Ser 648X-160

Distribution List:

DepComSubLant

ComSubPac

Mare Island NavShipYd

Ptsmth NavShipYd

SupShip Groton

SupShip NptNws

Copy to:

ComSubLant

SupShip Quincy

SupShip Camden

SupShip Pascagoula

Enclosure (1)

Procedures During Overhauls or Availabilities

1. The following is the recommended procedure for those ships undergoing overhaul or availabilities. Items completed during building or post shakedown periods should be eliminated.

a. Visually inspect all silver brazed joints in sea water systems two inch and over in accordance with Section 3B of NAVSHIPS 250-648-8. (After holding 1 1/2 times hydro one hour and while still under test pressure.

b. Examine by non-destructive test method either radiography or ultrasonic, any joint which fails on visual. Criteria for this inspection as follows:

1. X-Ray - The bottoming of the joints shall be such that the least penetration of the fitting extends at least 1/16" beyond the insert ring groove with an average overlap on the fitting side of not less than 1/8 of an inch. Insert ring must be melted.

2. Ultrasonic - 40% average bond both surfaces with a minimum bond of 25% of bonding surface either side of insert groove.

c. Check by non-destructive test all silver braze joints between and including hull valve and back up valve which can be done without major removals of machinery, piping, foundations or hull structure, to same criteria as above.

d. During visual inspection certify that materials used are correct. Paragraph 3f of NAVSHIPS 250-648-8 applies.

e. Hydro completed systems to 1 1/2 times test pressure.

f. All repairs to be in accordance with NAVSHIPS 250-637-2 of July 1961

Enclosure (1) to BuShips  
Ser 648X-160

Enclosure (2)

Listing of Applicable Submarines

Inspections in process or completed as of 1 February 1962:

SS(N)578	SS(N)588	SSB(N)608
SS(N)579	SS(N)590	
SS 580	SS(N)592	
SS 582		
SS(N)585		

To be performed during PSA:

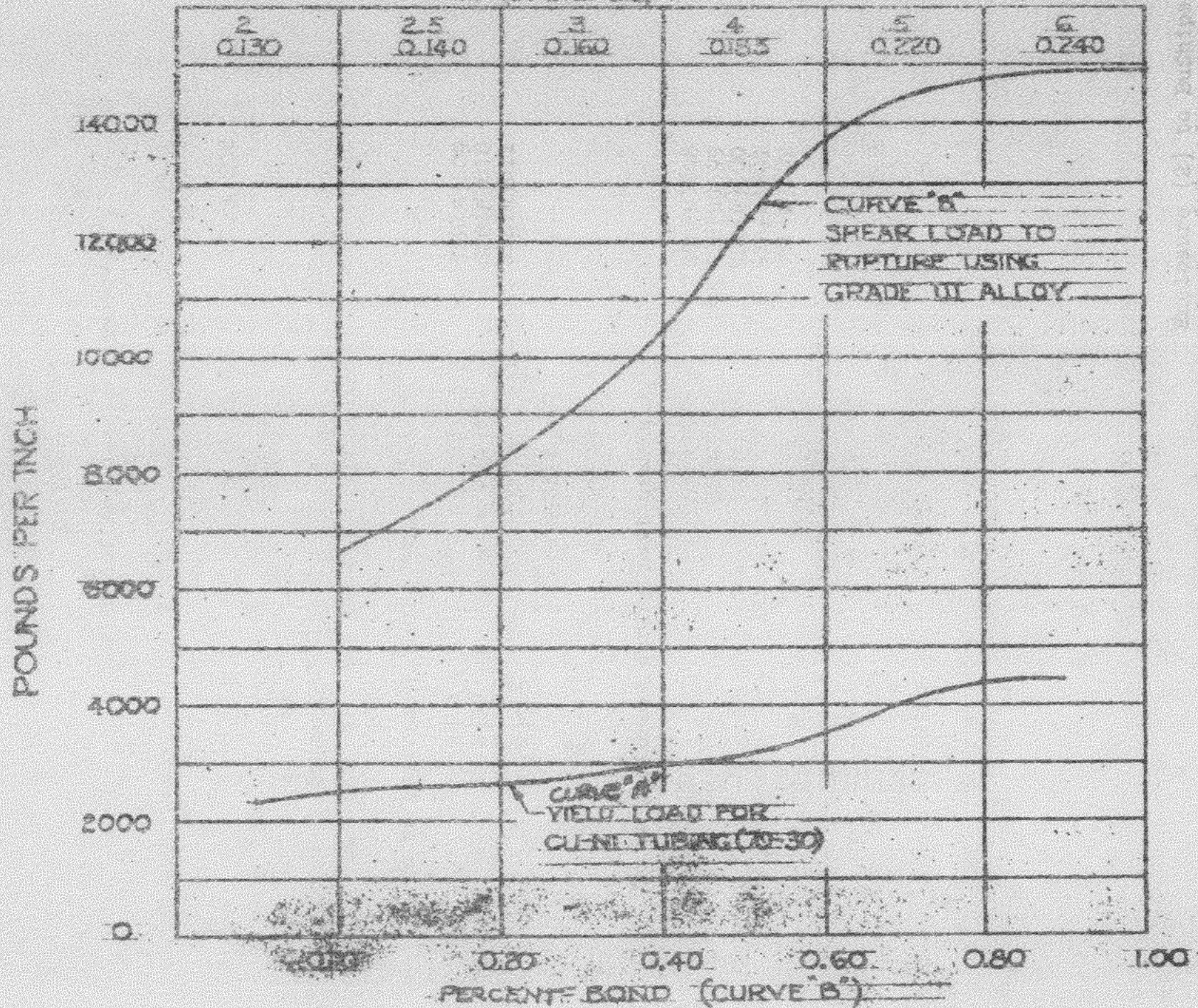
SS(N)593	SS(N)603	SSB(N)609
SS(N)594	SS(N)604	SSB(N)610
SS(N)595	SS(N)605	SSB(N)611
SS(N)596	SS(N)606	
	SS(N)607	

To be performed during next overhaul:

SS 563	SS(N)571	SSB(N)598
SS 564	SS(N)575	SSB(N)599
SS 565	SS(N)583	SSB(N)600
SS 566	SS(N)584	SSB(N)601
SS 567	SS(N)586	SSB(N)602
SS 568	SS(N)589	
SS 576	SS(N)591	
SS 581	SS(N)597	
SSG 574		
SSG 577		
SSG(N)587		

Enclosure (2) to BuShips  
Ser 648X-160

# PIPE SIZE 8 WALL THICKNESS (FOR CURVE "A" ONLY) (IN INCHES)



ENCLOSURE (31)

Enclosure (4)

Summary of E.E.S. Report 92093

Table 1  
Results of Leakage Testing  
Pressure-Cycling Test

Brazing Inches	Iron Pipe Size	Hydrostatic Test(1)	Tightness Testing After 3800 Pressure Cycles					
			From Interior to Insert Groove			From Exterior to Insert Groove		
			Halogen Detector	Soap Solution	Hydrostatic b(1)	Halogen Detector	Soap Solution	
1	2	None	None	None	None	None	None	None
2	2	None	None	None	None	None	None	None
3(4)	2	None	None	None	None	None	None	None
4	2	None	Leak	Leak	Leak(2)	(3)	None	None
5	2	Weep	Leak	Leak	Leak(2)	None	None	None
6	2	None	Leak	Leak	Bad Leak(2)	None	None	None
7	2	None	Leak	Leak	Bad Leak(2)	None	None	None
8	2	None	Leak	Leak	Bad Leak(2)	None	None	None
9	2	None	Leak	None	None	(3)	None	None
10	2	None	Leak	None	None	(3)	None	None
11	4	Slow Drip	Leak	None	None	(3)	None	None
12	4	None	Leak	Leak	Bad Leak(2)	(3)	None	None

- (1) Results were the same before pressure cycling and after 15,060 pressure cycles.
- (2) Upon returning the system to the pressure-cycling test, water squirted from the tapped test holes. Leaking holes were plugged; others were left open.
- (3) Halogen was detected within the probable leak area, but the source of the leak was not determined; hence, the indication was questionable.
- (4) 20% bond on brazes 4 thru 12.

Following paragraphs are excerpted for additional information and clarification of above table:

During the interruption, after 3800 cycles, it was decided to try a more sensitive procedure for determining the pressure tightness of the brazing. The object was to determine the integrity of the braze between the interior of the fitting and the insert groove and also between the insert groove and the exterior of the fitting. Accordingly, both ends of each fitting were drilled and tapped as shown in Enclosure (2). To determine the brazing integrity between the interior and the insert groove, trichloroethylene and air at 10 psi were applied to the inside of the system and gas samples were taken with a halogen leak detector at the tapped holes. To determine the brazing integrity between the insert groove and the exterior, a drop

Enclosure (4)  
to Ser 648X-160

Enclosure (4)

of trichloroethylene from a hypodermic syringe was injected into the insert groove through the tapped hole and 10 psi air pressure was applied by means of the adapter shown in Enclosure (2). The halogen leak detector was used to sample the gas around the exterior of the braze. In each instance, a soap solution was applied after the halogen leak test while the system was at 10 psi air pressure. Results of the leakage testing are given in Table 1.

It is of interest to note that brazes which leaked under hydrostatic pressure from the interior to the insert groove did not develop any leakage from the insert groove to the exterior as a result of the pressure-cycling test. Also, the two brazes which contained exterior leaks before the pressure-cycling test did not show any increase in leakage after 15,060 pressure cycles at 1.5 times the working pressure of the system.

Enclosure (4)



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

88N59301/9020  
Ser 525-781

12 APR 1963

From: Chief, Bureau of Ships  
To: Commander, Portsmouth Naval Shipyard

Subj: U/T of silver brazed piping

Ref: (a) BUSHIPS conf ltr C-88(N)59301/9020 Ser 525-0332 (c-7672)  
of 28 Aug 1962

1. Reference (a) directed certain U/T tests of silver brazed joints. It also requested the Shipyard to forward the test results, records, and any pertinent comments which seems pertinent.

2. It is requested that the Bureau be advised of the status of the U/T tests outlined in reference (a) and also have the approximate date the report will be forwarded to the Bureau.

(b) (6)

RECEIVED  
12 APR 1963

88(N) 59301/9020  
81623

Exhibit 159

MJC

303A-1  
SS(N)593C1/9020(81623)

APR 22 1963

From: Commander, Portsmouth Naval Shipyard  
To: Chief, Bureau of Ships

Subj: USS THRESHER (SS(N)593); Ultrasonic Testing of Silver Brazed Piping on

Ref: (a) BUSHIPS ltr SS(N)593C1/9020 Ser 525-781 of 1 Apr 1963  
(b) BUSHIPS Confidential ltr C-SS(N)593C1/9020 Ser 525-0332 of 28 Aug 1962  
(c) PHS ltr 213, SS(N)593/9480 of 9 Aug 1962  
(d) COMSUBLANT ltr FF4-12 9480/SS(N)593 Ser DEP402/M 6544 of 7 Sep 1962  
(e) PHS ltr to BUSHIPS 213 SS(N)593/9020 (C-7672) Ser 0226-62 of 5 Oct 1962

1. Reference (a) requested the status of the ultrasonic tests outlined in reference (b) and approximate date the report would be forwarded to the Bureau of Ships.

2. Reference (c) indicated the procedures for inspecting joints on S.W. systems. Reference (d) modified paragraph 2(A) of reference (c) by adding: "Ultrasonically test all sil-brazed joints between and including hull valve and back-up valve which can be done without major removals of machinery, piping, foundations or hull structure and test all suspect joints as defined by NAVSHIPS 250-648-8, found by this usual inspection." Reference (e) stated the priority of inspection and ultrasonic testing capabilities available.

3. The following results show the results of visual and ultrasonic inspection performed on sil-brazed joints in S.W. systems on USS THRESHER (SS(N)593).

Plan No.	System	Visual * Insp. only	Joints Accepted UT	Joints Rejected UT	New Joints Installed
1862606	A.S.W. Fwd	8	12	1	22
1862775	T & D	0	14	3	6 **
1862776	T & D	0	17	4	11
1862780	T & D	0	21	2	5
1862782	T & D	11	28	4	10
1862892	8000 GPD Still	26	33	6	13
TOTAL		45	125	20	67 ***

\*These 45 joints were found to be satisfactory according to NAVSHIPS 250-648-8. The attempt to UT these joints was unsuccessful because of

303A-1  
88(N)593C1

inaccessibility.

\*\*Five of these joints were replaced by welded joints.

\*\*\*The excess of 67 over 20 across from the removal of interference and connected piping in order to gain access to defective joints.

4. In addition to the 190 joints inspected and passed in connection with the foregoing job, 38 joints 2" IPS and over were made under other job orders during the availability. Of these, 21 were fabricated in the shop and inspected visually before and during hydrostatic test. The remaining seventeen were fabricated aboard ship and tested ultrasonically except for one, a tapered fitting which was accepted by visual examination during hydro.

5. Based on the sample observation, at least 87% of the joints throughout the ship can be said to have been acceptable with a confidence level of 90%. The average bond in the 20 rejected joints was indicated to be 39.5% prior to repair, with the lowest being 26%. The average percent bond indicated on the pipe-side land of these rejected joints was 63.5%, however.

C. J. PALMER

Copy to:  
BUSHIPS (Code 706)

300  
303  
303A  
213X  
865  
301D-1

Unclassified

VOLUME X OF 12 VOLUMES

RECORD OF PROCEEDINGS

of a

COURT OF INQUIRY

convened at

U. S. Naval Submarine Base New London  
Groton, Connecticut

and

Portsmouth Naval Shipyard  
Portsmouth, New Hampshire

by order of

Commander in Chief  
U. S. ATLANTIC FLEET

To inquire into the circumstances  
of the loss at sea of

USS THRESHER (SS(N)593)

which occurred on

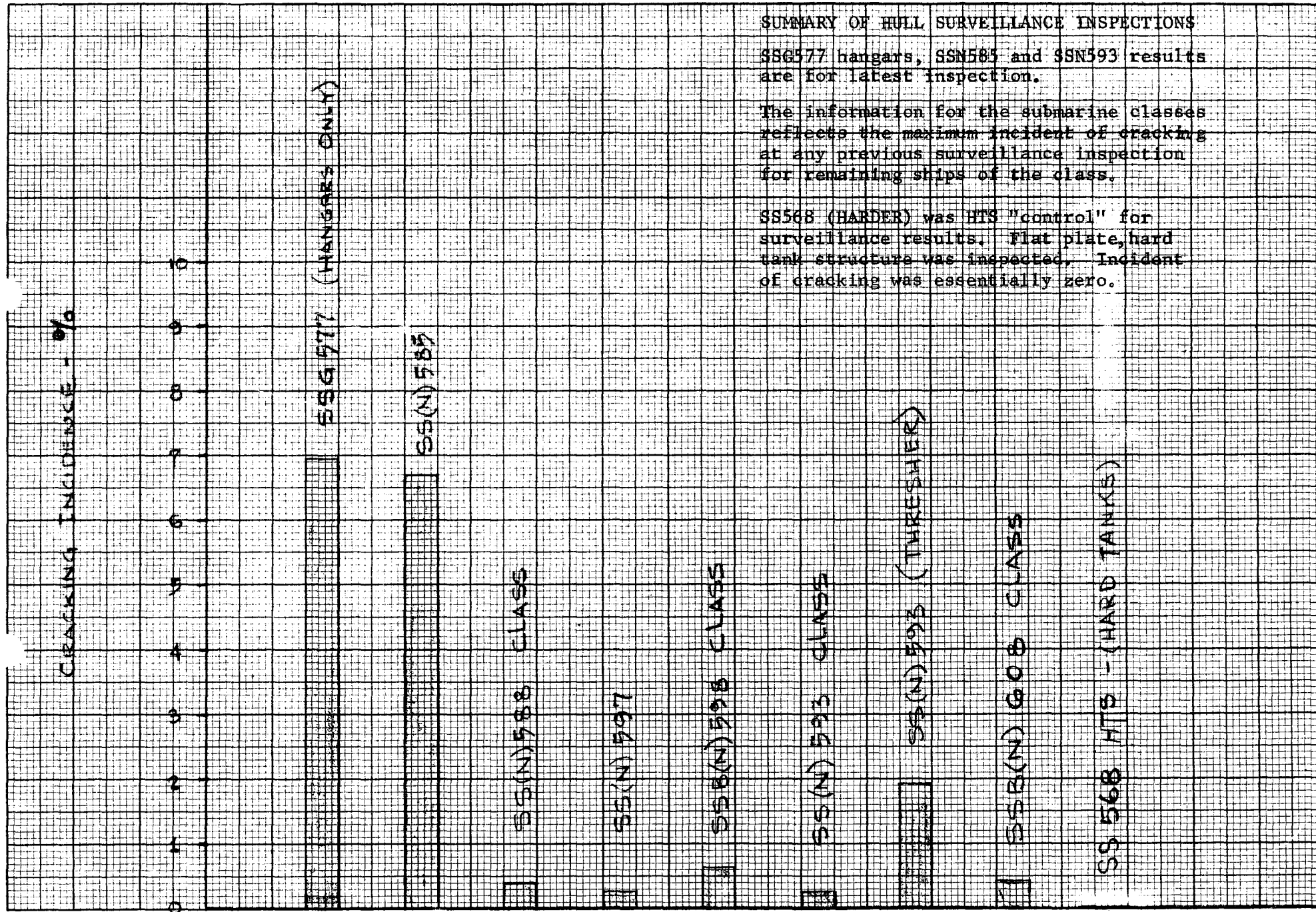
10 April 1963

Ordered on 10 April 1963

Unclassified

Exhibits 161 to 207

Unclassified



# SUMMARY OF HULL SURVEILLANCE INSPECTIONS

SSG577 hangars, SSN585 and SSN593 results are for latest inspection.

The information for the submarine classes reflects the maximum incident of cracking at any previous surveillance inspection for remaining ships of the class.

SS568 (HARDER) was HTS "control" for surveillance results. Flat plate, hard tank structure was inspected. Incident of cracking was essentially zero.

EXH 161

RECEIVED  
13 SEP 61 1618

L  
PP RBEPD RBEPW RBKHC RBKDR RBMP  
DE RBEGYC 006  
ZNR  
P 131410Z  
FM DEPCOMSUBLANT  
TO EUSHIPS  
INFO CNO  
CINCLANTFLT  
COMSUBLANT  
COMSUBPAC  
BT

UNCLAS

SUBMARINE SALT WATER PIPING SYSTEMS

A. CNO LTR SER 1356P43 OF 25 AUG

1. RECENT INSTANCES OF FLOODING IN SUBMARINES BECAUSE OF DEFECTIVE SEA WATER PIPING OR FLEXIBLE HOSES ARE CAUSE FOR GRAVE CONCERN.

2. CRITICAL REVIEW OF DESIGN PRINCIPLES AND FABRICATION TECHNIQUES AND PUBLISHING OF CORRECTIVE MEASURES RESULTED FROM BARBEL FLOODING INCIDENT. ALTHOUGH RECOGNIZING THAT NATURE OF PROBLEM WAS SUCH THAT IMMEDIATE AND COMPLETE

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SOLUTION NOT POSSIBLE TYCOM MUST EMPHASIZE THAT IN SPITE OF CORRECTIVE MEASURES LANTFLT SALT WATER PIPING INCIDENTS CONTINUE TO OCCUR WITH ALARMING REGULARITY. FOR EXAMPLE SUBSEQUENT TO BARBEL INCIDENT:

A. SKATE SHOCK TESTS - SILBRAZE JOINT FAILURES OCCURRED ON EACH SHOT. CAUSE ATTRIBUTED TO FAULTY DESIGN.

B. THRESHER FIRST BUILDERS TRIALS - **b(3) 10 USC 130**

SALTWATER VENT LINE JOINT FAILED, CAUSE ATTRIBUTED TO USE OF STEEL VICE MONEL PIPE.

C. THRESHER SECOND BUILDERS TRIALS - ONE INCH ID TRIM SYSTEM PRIMING LINE FAILED DUE LACK SILBRAZE INSERT RIGN.

D. ETHAN ALLEN BUILDERS TRIALS - THREADED PLUG BLEW OUT OF TRIM LINE PRIMING LINE STRAINER. ELECTRICAL SWITCHBOARDS WERE SPRAYED, REACTOR SCRAMMED, MINOR FIRES ENSUED. CAUSE ATTRIBUTED TO USE OF IMPROPER STRAINER INCORPORATING PLUG WITH TAPERED PIPE THREADS.

E. SNOOK FIRST BUILDERS TRIALS - THREE GREASE LINES PASSING ATTRIBUTED TO FAULTY WORKMANSHIP ON FLARED FITTINGS, ONE AND ONE QUARTER INCH NIPPLE IN HPAC COOLING WATER DISCHARGE

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PULLED OUT OF PIPE BOSS AT TEST DEPTH.

CAUSE ATTRIBUTED TO USE OF STAINLESS VICE MONEL PIPE. SUBSEQUENT INSPECTION DURING TRIAL REVEALED LEAKING SILBRAZE JOINT IN FIVE INCH LINE.

3. RECENTLY FOLLOWING INCIDENTS HAVE OCCURRED BECAUSE OF FLEXIBLE HOSE FAILURES:

A. IN LANTFLT, ARGONAUT FLOODED AFTER ENGINE ROOM AND GROUNDED **b(3) 10 USC 130** WHEN RETAINING RING ON AEROQUIP FLEX HOSE FITTING FAILED.

B. IN PACFLT, CAIMAN FLOODED FORWARD ENGINE ROOM WHEN FOUR INCH FLEX HOSE BURST NEAR TEST DEPTH.

4. WE HAVE BEEN FORTUNATE THUS FAR IN THAT CASUALTIES HAVE BEEN HANDLED PROMPTLY AND CORRECTLY AND THAT, EXCEPT IN CASE OF ETHAN ALLEN, ELECTRICAL APPARATUS HAS NOT BEEN INVOLVED. CONTINUED DEPENDENCE UPON SUCH TENUOUS AND FORTUNATE CIRCUMSTANCES, PARTICULARLY WHEN CONSIDERING ADDITIONAL HAZARDS IMPOSED UNDER WARTIME CONDITIONS, IS OBVIOUSLY UNACCEPTABLE. COMSUBLANT APPRECIATES EFFORTS EXPENDED AND RESULTS ALREADY ACHIEVED BY BUSHIPS IN IMPROVING SITUATION. HOWEVER, IT IS CONSIDERED THAT URGENCY

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OF PROBLEM AND INHERENT DANGER OF DISASTER MUST BE BROUGHT MORE FORCIBLY TO ATTENTION OF ALL CONCERNED AND THAT CORRECTIVE/PREVENTIVE ACTION MUST BE PURSUED EVEN MORE AGGRESSIVELY THAN HAS BEEN DONE. TO THIS END, IT IS REQUESTED THAT BUSHIPS TAKE THE FOLLOWING ACTION ON A TOP PRIORITY BASIS:

A. IMPRESS ON ALL BUILDING YARDS THE SERIOUS CONSEQUENCES OF LAXITY IN DESIGN AND FABRICATION OF SUBMARINE PIPING SYSTEMS. AS EXEMPLIFIED IN ETHAN ALLEN, A SEEMINGLY MINOR DEPARTURE FROM THE RULES CAN PRODUCE COMPLEX CASUALTIES WHICH IMPERIL THE LIVES OF SUBMARINERS AND/OR RENDER THE SHIP UNABLE TO PERFORM HER MISSION.

B. EXPEDITE ACTION TO ELIMINATE IMPROPERLY DESIGNED CONNECTIONS FROM ALL OPERATING SUBMARINES.

C. EXPEDITE REPLACEMENT OF STEEL RETAINING RINGS ON FLEX HOSES WITH MONEL AND REVIEW FLEX HOSE FAILURES TO DETERMINE WHAT FURTHER CORRECTIVE ACTION MAY BE REQUIRED TO PROVIDE RELIABLE INSTALLATIONS.

D. EXPEDITE DEVELOPMENT OF RELIABLE NON-DESTRUCTIVE TEST METHOD FOR SILBRAZE FITTINGS. THIS IS URGENTLY NEEDED TO ENABLE OPERATING

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FORCES TO LOCATE AND REPAIR DEFECTS.

E. IN NEW DESIGN, REDUCE WHEREVER POSSIBLE POTENTIAL HAZARD OF SALTWATER SPRAY DAMAGE TO ELECTRICAL EQUIPMENT BY PHYSICAL SEPARATION, SHIELDING OF SALTWATER LINES, PROVISION OF WATERTIGHT CLOSURES FOR ELECTRICAL EQUIPMENT, OR OTHER APPROPRIATE MEANS.

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#### BACKGROUND

The seriousness of a flooding casualty has increased as submarines operate at deeper depths. This problem is compounded by the large compartment volumes, and the large sizes and quantity of sea water piping required in nuclear powered submarines.

Recognition of the seriousness of this deep depth flooding problem has been evidenced by many design changes incorporated into submarines with deeper test depth capabilities; for example, provision of power operated valves, centralized sea valve operating stations, improvement in piping joint reliability by welding and improved quality control, reduction of the amount of internal sea water piping, and provision of remote power operated MBT blow valves.

Continuing concern for safe deep depth operation has occasioned the current studies of the overall submarine flooding recovery capability. These studies have been used primarily to determine whether design changes to submarine systems are necessary, and are not at this time complete for any one class. It is intended to examine each submarine class to determine its flooding recovery capability and to provide appropriate information to permit operation with minimum risk from flooding type casualties. This brief interim report provides preliminary results from the studies conducted to date and is primarily intended to give generalized information of the effect of the various variables on recovery.

#### DISCUSSION

The following variables have a major effect on a submarine's ability to recover from flooding:

- Type Casualty
  - Hole size
  - Location of flooding
- Operational considerations
  - Depth
  - Time to secure flooding
  - Initial ship speed
  - Ship acceleration
  - Air bank pressure
  - Time to initiate MBT blow
  - Attempting compartment pressurization
- Design features
  - Air bank capacity
  - MBT blow rate

Unclassified

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DOD DIR 5200.10

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These variables are interrelated in their effect on the problem, and therefore, are being evaluated primarily by computer studies where certain inputs are held constant while others vary. The effect of these variations based on a few representative computer runs is included here to illustrate the general influence of these variables on recovery.

#### TYPE CASUALTY

Hole size directly influences flooding:

$$\text{Flow} \sim \text{Hole Area} \sim (\text{Pipe diameter})^2$$

Coupled with depth, it determines the flooding rate and, with time to secure, the total water taken in. Figures 1 and 2 illustrate these relationships. The curves reflect a theoretical coefficient of discharge and hole size by pipe diameter, whereas actual flooding is strongly influenced by the type of failure and whether flooding occurs from both the suction and discharge ends of a piping system failure. Studies have been made to relate these hole sizes to actual system failures; however, ships' force would probably determine the potential seriousness of flooding by location and a quick estimate of intensity rather than by curves and nomographs. Check valves are being specified for the discharge of most sea water systems to prevent double ended flooding. Also, a study is being conducted with the aim of providing a "rig for deep dive" position on large sea valves to restrict flooding potential at deep depth. b(3) 10 USC 130

The Location of Flooding has an important influence on recovery because it affects the trim of the submarine and it may cause electrical fires or otherwise damage equipment. The source of largest potential flooding is from the extensive sea water piping aft. In such a situation, propulsion power can be extremely useful for recovery in that an up angle will result, but severe flooding may cause failure of the plant due to electrical damage.

#### OPERATIONAL CONSIDERATIONS

Depth influences flooding recovery in several ways. It may be the sole cause of a failure or a strong contributor if depth charge or other forms of shock are present. Once a failure occurs, depth provides the pressure head that determines the rate of water flow into the ship.

$$\text{Flow rate} \sim \sqrt{\text{depth}}$$

Depth also determines the extent to which air can expand in the ballast tanks to force out water. Figures 1 and 2 give an indication of the effect of depth on recovery.

The Time to Secure Flooding from a particular casualty determines the total amount of water taken in and is illustrated by Figures 1 and 3. Quick action is necessary to assure recovery from the flooding situation; hence, the recent provision in submarine designs of remote power actuated sea valves. The use of devices to detect flooding and automatically effect

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Closure of valves is being studied. They have not been specified for installation in current submarine designs because they would introduce additional complexity into the ship, might deny the use of propulsion power for recovery, and could cause plant shutdown from spurious signals. The extent of use of these devices require more detailed analysis. The use of "rig for deep dive" sea valve positions in large lines seems more attractive at this time, since it would reduce flooding without greatly reducing available ship's power and would reduce closure time. Automatic flooding indication is also being considered to assist operators to take quicker closure action.

Initial Ship Speed provides a significant recovery capability, as shown in Figures 3, 4 and 5, unless flooding is forward. Even if propulsion power is lost due to flooding, the ship's momentum could significantly assist recovery. The use of speed alone in recovery from small casualties is desirable because it permits better control of the ship than does MBT blowing. Further studies are being conducted to determine optimum speed-depth combinations to minimize the hazards from flooding. However, it should be noted that a four knot speed is marginal for improving recovery over the zero speed condition.

Ship acceleration assists in recovery from flooding. In the event of flooding aft while proceeding at four knots at test depth, ordering full power would about double the amount of flooding from which a submarine could recover by blowing alone.

Air bank pressure affects initial blow rate and the quantity of air for sustained blowing for surfacing quickly. Recovery capability decreases significantly with decreased air bank pressure. Preliminary studies indicate that when air bank pressure drops to one-half design pressure the maximum continuously flooding hole from which the ship can recover is reduced by one-half diameter.

Time to initiate MBT blow after flooding starts is a vital contributor to recovery. For most studies it has been assumed MBT blow will be initiated in 15 seconds.

Any influx of sea water into the ship must be countered with at least a corresponding discharge of water from the ballast tanks as soon as possible. Figure 6 illustrates the difference in continuous flooding hole sizes from which the ship could recover assuming different times for initiating MBT blow. Another reason for early MBT blow can be illustrated by Figure 7. During the first 60 seconds, the severity of flooding would not be apparent from any ship motion. Also the difference in the size of the flooding source may be difficult to ascertain. Therefore the early initiation of tank blow may become the factor affecting ship recovery.

Compartment pressurization to counteract flooding is not feasible at significant depths, and the times to pressurize, even using high pressure air directly, are too great to assist recovery. Of greater importance is the fact that use of the internal salvage system starves the MBT blowing contribution to recovery. Therefore, compartment pressurization should be done only at shallow depths. Figure 8 illustrates this effect for a SSB(N) ~~596~~ Class ship with a greatly improved MBT blow capability.

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### DESIGN FEATURES

Air bank capacity determines the sustained blowing capability for recovery. Determination of air bank capacity and pressure has previously been based on the following operational considerations:

1. Two complete MBT blows at surface pressure
2. An additional MBT blow for SSB(N) surface missile launch
3. Firing all torpedoes
4. Residual pressure of **b(1)** in air banks after above evolution. This criteria is now being extended to include sufficient capacity for flooding recovery.

Propellant type gas generators are being considered for blowing MBTs as a supplement to air. Studies of future submarine designs of deeper test depth capability indicate that the air bank capacities required for recovery from flooding will present unacceptable weight penalties.

MBT Blow Rate is determined primarily by the bank pressure and capacity and by the piping system between bank and tank. Existing blow rates are considerably less than required to recover from a large pipe failure and are being ~~increased~~<sup>ing</sup> to provide a greater recovery capability by leading high pressure air directly back to the tank without going through reducers or mains.

STUDIED WITH A VIEW

### INTERIM DESIGN CRITERIA

To provide a ship flooding recovery capability sufficient to cause the ship to surface after any single sea water piping casualty, assuming the following ship conditions:

- (1) Ship at test depth
- (2) Ship has zero speed\*
- (3) Ship has zero trim
- (4) Ship has neutral buoyancy

**b(1)**

#### EVALUATING

\* For Backfit use 5 knots INITIAL SPEED

The recovery capability is based on the following assumptions:

- (1) Ballast tank blow is initiated 15 seconds after casualty.
- (2) Air bank pressure **b(1)**
- (3) Sea valves are undamaged and operating personnel are available at normal watch stations.
- (4) Sea valves are secured **b(1) 10 USC 130** for personnel decision plus time to close based on size and type of valve and location of valve controls.
- (5) Where manually initiated closing of a sea valve is not adequate valve opening is restricted before going deep (rig for deep dive) or an automatic positioning device ~~is installed~~ to partially or fully close the valve in event of casualty.
- (6) Ship does not go below collapse depth.
- (7) Ballast tanks are not overstressed.
- (8) Ship angle does not exceed 30°.
- (9) Propulsion power is not available, if piping casualty in question could affect main propulsion.

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#### SUMMARY

The foregoing presents in a qualitative manner facts well known to submarine operators, namely, that recovery capability from a flooding casualty is reduced if the air bank pressures are low, the ship is deep, or at slow speed. They also know that in the event of flooding quick action is required to secure flooding, blow main ballast tanks, and apply power. Again emphasized is the danger and futility of trying to pressurize compartments at deep depths.

The information presented herein is a small part of the total being generated for use in providing an improved submarine recovery capability. More detailed information will be provided as it becomes available.

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## ATTACHMENT 1

### FIGURES

- Figure 1. Time to secure opening vs. hole size at various depths.
- Figure 2. Effect of depth on recovery from continuous flooding hole.
- Figure 3. Time to secure sea valves versus initial speed.
- Figure 4. Continuous flooding hole size vs. initial ship speed.
- Figure 5. Continuous flooding hole size vs. depth.
- Figure 6. Effect of delay in initiating MBT blow.
- Figure 7. Ship motion during flooding
- Figure 8. Effect of compartment pressurization on recovery capability.



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AMOUNT OF STORED AIR  
FOR M.B.T. BLOW

SS(N)	AIR BANK	b(1)		% OF BALLAST TANK BLOWN	TONS OF BALLAST BLOWN AT DEPTH
571	678			29.0	168
575	675			29.0	167
578	530			41.7	124
585	666			36.5	157
593	405			13.4	75
593(FY 62)	570			19.4	108
637	870			33.0	177

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GP 3 4/30/63

b(1)



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

SSN593C1/9480  
Ser 648D2-18  
8 March 1963

From: Chief, Bureau of Ships  
To: Supervisor of Shipbuilding, U. S. Navy, Pascagoula  
Supervisor of Shipbuilding, U. S. Navy, Camden  
Supervisor of Shipbuilding, U. S. Navy, Groton

Subj: SSN593 Class; Hydraulic operators for backup valves in Main sea water system, Comments on

Ref: (a) Specifications for Building Submarines SSN593 Class

1. It has been brought to the attention of BuShips that some contractors are not installing hydraulic operators on the main sea water system suction and discharge back-up valves as required by reference (a).
2. Section S21-1, Page 250, lines 31-32 of reference (a) specify that the main hydraulic system shall furnish power to the main sea water suction and discharge valves. This includes the hull and back-up valves.
3. This is a Contractor responsible item and should be completed prior to delivery of ships. If not, this item should be added to the PAT work list as Contractor responsibility.

b (6)

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INSURVPAC  
COMNAVSHIPYD PTSMH

W.J. CARTIN  
By direction

BuShips Codes:  
525 648D2  
640 648W  
648D 525T

(b) (6)

EX164



Ser 648D21-M66

14 FEB 1963

MEMORANDUM

From: Code 648D

To: Code 525H

Subj: Ships in Service - Additional remote sea water valve actuators and valves, Provision for

Encl: (1) Proposed ShipAlt to provide remote valve actuators for selected sea water system valves and additional valves as necessary to increase safety of submarines in service

1. Submarine Type Commanders have strongly recommended the installation of additional remote controlled hydraulically operated valves and/or remote hydraulic operators for existing valves in auxiliary sea water cooling systems. These requests were based on the necessity for increased sea water system reliability due to the greater operating depths of present submarines and the possibility of pipe or flexible connection failure, with consequent flooding of a compartment, which could result in the loss of the ship if no rapid means of partial or complete system isolation is provided.

2. Based on a sea water piping system review, new remote controlled hydraulically operated valves, new check valves, stop-check valves, and remote hydraulic operators are proposed where necessary. These proposals are contained in enclosure (1). The location of the new valves and the selection of the existing valves to be provided with remote operators will permit, in the event of a pipe or flexible connection failure, the isolation of the affected section of the system while maintaining reduced steam propulsion power enabling the ship, if necessary, to approach the surface in a controlled manner.

b(6)

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(b) (6)

EXHIBIT (166) - 1

SHIPALT SS(N), SSB(N)

**Brief** - Provide remote valve actuators for selected sea water system valves and additional valves as necessary to increase safety of ship

1. **Plans** - In accordance with BuShips Inst. 4720.6B.
2. **Material** - to be provided by installing activity.
3. **Estimated weight** - see below.
4. **A.** In order to increase the safety of the subject ships, means of remote hydraulic operation from upper levels are to be provided for the below listed sea water isolation **b(3) 10 USC 130** valves. In addition, check valves should be installed and stop valves converted to manually operated stop-check valves as noted. If arrangements prohibit the conversion of the listed stop valves to stop-checks, check valves shall be installed upstream of these valves.

(1) For the SS(N)571:

est. wt. approx. 0.32 ton centered approx. 11 ft above B.L.  
at approx. FR 62.

(a) V-1 (5") diesel generator and H.P. air compressor sea suction in engine room.

(b) Convert V-5 (4") diesel gen. ovbd. discharge backup valve in engine room to a stop-check valve.

(c) V-3 **b(3) 10 USC 130** SSTG air cooler and air ejector ovbd. discharge in engine room.

(d) (2½") combined suction for battery and fwd M.C. set in fwd. aux. machinery space.

(e) V-1 (6") air conditioning sea suction, one in engine room and one in stern room.

(f) V-11 (5") air conditioning ovbd. discharge, one in engine room and one in stern room.

(g) V-1 (6") E.P. motor sea suction in engine room.

(h) V-12 (2½") E.P. motor ovbd. discharge in engine room.

ENCL (1) TO SER 648D21-M66

(1) V-19 b(3) 10 USC 130 #1 & #2  
refrig. cond., and #1 & #2 control air compressors overboard  
discharge in engine room.

(j) Trim pump sea suction and discharge (3") in  
control room.

(k) Drain pump ovbd. discharge (2½") in engine  
room.

(1) V-10 b(3) 10 USC 130 main air  
ejectors, CTG air coolers, and main L.O. coolers ovbd. dis-  
charge in engine room.

(2) For the SS(N)575:

est. wt. approx. 0.37 ton centered approx. 9.7 ft. above B.L.  
at approx. FR 62.

(a) V-2 (6" - one port, one stbd.) combined sea  
suction (hull) for diesel generators, air conditioning, and  
H.P. air compressors in engine room.

(b) V-18 (4") diesel generator ovbd. discharge  
in engine room.

(c) V-12 (5") H.P. air compressor and air condition-  
ing ovbd. discharge in engine room.

(d) MSW-35 b(3) 10 USC 130 main circulating b(3) 10 USC 130  
in engine room.

(e) MSW b(3) 10 USC 130 main air ejector and  
main L.O. cooler ovbd. discharges in engine room.

(f) SSSW - 46 b(3) 10 USC 130 SSTG b(3) 10 USC 130 in engine  
room.

(g) Convert SSSW - b(3) 10 USC 130 SSTG air  
coolers, air ejectors, and L.O. coolers ovbd. discharge backup  
valves in engine room to stop-check valves.

(h) SWR b(3) 10 USC 130 R.C. sea suction in engine  
room.

(i) ASW-27 b(3) 10 USC 130 M.G. set ovbd. discharge in  
engine room.

(j) ASW b(3) 10 USC 130 propulsion motors and aux.  
machinery sea suction in engine room.

(k) ASW-13 **b(3) 101** propulsion motors ovbd. discharge in engine room.

(l) Trim pump sea suction & discharge (3") in control room.

(m) Drain pump ovbd. discharge (2½") in engine room.

(3) For the SS(N)578 Class and the SSC(N)587:

est. wt. approx. 0.33 ton (0.43 tons for 579 & 584) centered approx. 6 ft. above B.L. at approx. FR 64.

(a) ASW **b(3) 10 USC 130** sea suction for ASW pumps in engine room.

(b) TD-49 (2½") drain pump ovbd. discharge in engine room (TD-168 for SSC(N)587).

(c) TD-37 (3") trim system sea suction & discharge in control room (TD-88 for the SSC(N)587).

(d) MSW-27 **b(3) 101** main sea water **b(3) 10 USC 130** in engine room.

(e) ASW-212 **b(3) 101** after ASW **b(3) 10 USC 130** in engine room.

(f) Convert ASW-95 and 102 **b(3) 11** in E/R-578, 583, 587), ASW-94 and 247 **b(3) 11** in R.C.-579, 584), ASW-87 **b(3) 11** in E/R-578, 583, 587), and ASW-246 **b(3) 11** in R.C.-579, 584) FW/SW heat exchangers' outlet and ovbd. discharge backup valves to stop-check valves.

(g) ASW-21 **b(3) 11** ASW pumps discharge header **b(3) 10 USC 130** in engine room.

(h) ASW-7 **b(3) 11** on SS(N)578, 583 and SSC(N)587 - ASW pumps suction header **b(3) 10 USC 130** in engine room - on SS(N) 579 and 584 install a hydraulically actuated valve similar to ASW-7 on SS(N)578.

(4) For the SS(N)585:

est. wt. approx. 0.19 ton centered approx. 8.6 ft. above B.L. at approx. FR 66.

(a) SWD-5 (2½") diesel generator ovbd. discharge in aux. machinery space.

(b) TD-4 (2½") drain pump ovbd. discharge in aux. machinery space.

(c) TD-5 (4") trim system sea suction and discharge in aux. machinery space.

(d) ASW-b(3) 10 USC 130 sea  
suctions in aux. machinery space.

(e) ASW-134 and 135 b(3) 10 air conditioning and H.P. air compressors sea suction in engine room.

(f) ASW-220 b(3) 10 USC 130 sea suction  
in engine room.

(g) ASW-256 b(3) 10 U ASW b(3) 10 USC 130 in engine room.

(5) For the SS(N)586:

est. wt. approx. 0.28 ton centered approx. 8.4 ft. above B.L.  
at approx. FR 126.

(a) CWD-23 (3") diesel generator sea suction in aux. machinery space #1.

(b) Convert CWD-14 (2½") diesel generator overboard discharge backup valve to a stop-check valve.

(c) ACW-12 (5") air conditioning sea water suction in aux. machinery space #3.

(d) ACW-11 (5") air conditioning ovbd. discharge in aux. machinery space #3.

(e) TD-1 (3") trim system sea suction and discharge in engine room #1.

(f) TD-138 (2½") drain pump ovbd. discharge in aux. machinery space #2.

(g) ACW1-140 (5") FW/SW coolers ovbd. discharge in engine room #1.

(h) ACW1-141 b(3) 10 USC 130  
#1 ovbd. discharge in engine room #1.

(i) ACW1-144 b(3) 10 USC 130  
ovbd. discharge in engine room #1.

(j) ACW2-140 b(3) 10 USC 130  
#2 ovbd. discharge in aux. machinery space #2.

(k) ACW2-141 b(3) 10 USC 130  
#2 overboard discharge in auxiliary machinery space #2.

(l) ACW2-144 b(3) 10 USC 130  
overboard discharge in engine room #2.

(m) ACW2-145 and 153 (5") air conditioning overboard discharge in engine room #2.

(6) For the SS(N)588 Class:

est. wt. approx. 0.19 ton centered approx. 8.6 ft. above B.L.  
at approx. FR 66.

(a) SWD-5 (2½") diesel generator overboard discharge in aux. machinery space.

(b) TD-5 (4") trim system sea suction and discharge in aux. machinery space.

(c) TD-4 (2½") drain pump overboard discharge in aux. machinery space.

(d) ASW- b(3) 10 USC 130 sea  
suction in aux. machinery space.

(e) ASW-214 and 215 b(3) 10 air conditioning and  
H.P. air compressors sea suction in engine room.

(f) ASW- b(3) 10 USC 130 sea suction  
in engine room.

(g) ASW-273 b(3) 10 USC 130 in engine  
room.

(7) For the SS(N)593 and 594:

est. wt. approx. 0.62 ton centered approx. 8.9 ft. above B.L.  
at approx. FR 82.

(a) TD-164 (3") drain pump ovbd. discharge in  
engine room.

(b) ASW-61 b(3) 10 ovbd. discharge header cross-  
connect in aux. machinery space.

(c) ASW- b(3) 10 USC 130 discharge  
cross-connect in aux. machinery space.

(d) ASW-66 **b(3) 10** ovbd. discharge header cross-connect in engine room.

(e) ASW-**b(3) 10 USC 130** discharge cross-connect in engine room.

(f) Install check valves **b(3) 10** downstream of ASW-168 and ASW-167 and install a hydraulically operated stop valve **b(3) 10** in the common sea water supply line (P-61) to after end of engine room.

(g) Install check valves **b(3) 10** downstream of ASW-192 and ASW-193 in the sea water ovbd. discharge in after end of engine room.

(h) Install hydraulically operated valves **b(3) 10** in the **b(3) 10 USC 130** supply headers in the engine room just aft of the AMS/E.R. bulkhead and install normally closed stop valves in the **b(3) 10 USC 130** ovbd. discharge headers in the engine room just aft of the AMS/E.R. bulkhead.

(8) For the SS(N)597:

est. wt. approx. 0.24 ton centered approx. 5.8 ft. above B.L. at approx. FR 60.

(a) DSW-1 (3") diesel generator sea suction in forward aux. machinery space.

(b) Convert DSW-20 (3") diesel generator ovbd. discharge backup valve to a stop-check valve.

(c) ASW-**b(3) 10 USC 130** suction in engine room.

(d) TD-39 (2½") drain pump ovbd. discharge in engine room.

(e) TD-4 (4") trim system sea suction and discharge in engine room.

(f) TD-114 (1½") pyro and small arms locker flood in forward aux. machinery space.

(g) ASW-190 and 177 **b(3) 10** aux. sea water supply cross-connect in engine room.

(h) ASW-17 **b(3) 10** ASW pumps discharge header cross-connect in engine room.

(i) ASW-63 **b(3) 11** ASW pumps suction header cross-connect in engine room.

(j) Install check valves **b(3) 11** downstream of ASW-61 and ASW-68, sea water supply to FW/SW heat exchangers in engine room.

(k) Convert ASW-30 **b(3) 10** air conditioning sea suction cross-connect in engine room to abnormally-closed valve.

(9) For the SSB(N)598 Class:

est. wt. approx. 0.27 ton centered approx. 8.8 ft. above B.L. at approx. FR 57.

(a) SWD-5 (2½") diesel generator ovbd. discharge in aux. machinery space.

(b) TD-4 (2½") drain pump ovbd. discharge in aux. machinery space.

(c) TD-5 (4") trim system sea suction and discharge in aux. machinery space.

(d) SWF-9 (3") ovbd. discharge from coolers in gyro room.

(e) SWF-1 **b(3) 10 USC 130** sea suction in gyro room.

(f) SWA-43 (4") air conditioning unit #5 sea suction in missile compartment.

(g) SWA-1 (3") CO<sub>2</sub> scrubbers, O<sub>2</sub> generator and H.P. air compressors sea suction in missile compartment.

(h) ASW-214 and 215 **b(3) 10 1** air conditioning and H.P. air compressor sea suctions in engine room.

(i) ASW-356 **b(3) 10 USC 130** sea suction in engine room.

(j) ASW-273 **b(3) 10 1** ASW **b(3) 10 USC 130** in engine room.

(k) ASW-**b(3) 10 USC 130** sea suction in aux. machinery space.

B. The sea water valves shall be solenoid actuated hydraulically operated from one control station located on the upper level of the compartment in which they are installed except for the trim system sea valves which shall be controlled from BCP in the control room. They shall be provided with standby hand operated hydraulic pumps adjacent to the valve control station in the compartment in which they are located for use

in the event the main hydraulic system is inoperable. Each hand pump shall serve no more than 5 hydraulically operated sea water valves. The control station and hand pump(s) for the sea water valves in the engine room shall be located adjacent to the existing main sea water valve control station. Remaining control stations shall be located in a conveniently accessible, normally unlocked space, and should not interfere with free passage in walking areas or form an obstruction in working areas if possible. The valve rate of opening and closing for all these hydraulically operated valves shall be such as to preclude detrimental pressure surges in their systems. The two hydraulically operated valves to be installed as noted in paragraph 4.A. - 7-(h) above shall be provided with, in addition to their main control station in the engine room, electric position indicators and overrides to shut at the valve control station in the auxiliary machinery space. Existing components should be utilized as much as possible.

C. Estimated cost (approximate):

- (1) SS(N)571, converting 15 valves to hydraulic operation and 1 valve to a stop-check \$74,000.
- (2) SS(N)575, converting 16 valves to hydraulic operation and 2 valves to stop-checks \$73,700.
- (3) a. SS(N)578, 583 and SSC(N)587, converting 8 valves to hydraulic operation and 4 valves to stop checks \$119,300 for 3 ships.  
b. SS(N)579 and 584, converting 7 valves to hydraulic operation and 4 valves to stop-checks, plus installing 1 hydraulically operated valve \$86,300 for 2 ships.
- (4) SS(N)585 and SS(N)588 Class, converting 9 valves to hydraulic operation \$250,800 for 6 ships.
- (5) SS(N)586, converting 13 valves to hydraulic operation and 1 valve to a stop-check \$60,600.
- (6) SS(N)593 and 594, converting 5 valves to hydraulic operation, and installing 3 hydraulically operated valves, 2 manually operated valves and 4 check valves \$104,000 for 2 ships.
- (7) SS(N)597, converting 10 valves to hydraulic operation and 1 to a stop-check, and installing 2 check valves \$52,500.
- (8) SSB(N)598 Class, converting 13 valves to hydraulic operation is approximately \$301,500 for 5 ships.

(9) Total estimated cost is \$1,154,700 which includes design, material, and labor.

APPLICABLE SHIPS

SS(N)

NAUTILUS (SS(N)571)  
SEAWOLF (SS(N)575)  
SKATE (SS(N)578)  
SWORDFISH (SS(N)579)  
SARGO (SS(N)583)  
SEADRAGON (SS(N)584)  
SKIPJACK (SS(N)585)  
TRITON (SS(N)586)  
HALIBUT (SSG(N)587)  
SCAMP (SS(N)588)  
SCORPION (SS(N)589)  
SCULPIN (SS(N)590)  
SHARK (SS(N)591)  
SNOOK (SS(N)592)  
TERESHER (SS(N)593)  
PERMIT (SS(N)594)  
TULLIBEE (SS(N)597)

SSB(N)

GEORGE WASHINGTON (SSB(N)598)  
PATRICK HENRY (SSB(N)599)  
THEODORE ROOSEVELT (SSB(N)600)  
ROBERT E. LEE (SSB(N)601)  
ABRAHAM LINCOLN (SSB(N)602)

CHANGE ORDER JUSTIFICATION MEMORANDUM  
NAVSHIPS 4577 (REV. 12-61)

SUBJ: **Partial elimination of  
submarine sea water system  
constant vent lines**

FROM: CODE 648  
TO: CODE 406F  
VIA: CODE 525

SHIP(S) **SS(N)593 Class (less 593, 594, 595)  
SSB(N)616 Class** CONTRACT (PROJECT) \_\_\_\_\_ CHANGE ORDER NO. \_\_\_\_\_

CHANGE ORDER CATEGORY		
<input type="checkbox"/> MUST BE DONE DURING BUILDING	<input checked="" type="checkbox"/> SHOULD BE DONE DURING BUILDING	<input checked="" type="checkbox"/> NO COST CHANGE ORDER

ESTIMATED EFFECT ON CONTRACT (Project)	
INCREASE/DECREASE IN COST \$ <b>* - see below</b>	DELAY IN COMPLETION <input checked="" type="checkbox"/> NO <input type="checkbox"/> YES (Explain below under remarks)

TYPE OF CHANGE	
<input type="checkbox"/> ADMINISTRATIVE (Includes change of delivery, fitting out, insurance claims, etc.)	<input type="checkbox"/> FLEET INITIATED CHANGES (POO, TYCOM, INSURV)
<input type="checkbox"/> CONTRACTOR REQUESTED CHANGES OR SHIP REQUESTED CHANGES	<input type="checkbox"/> CHANGES INITIATED BY OTHER BUREAUS
<input checked="" type="checkbox"/> DESIGN IMPROVEMENT ORIGINATED IN BUREAU OF SHIPS. CODE <b>648</b>	<input type="checkbox"/> SCB OR CNO INITIATED CHANGES
<input type="checkbox"/> ERROR, OMISSION, AND CLARIFICATION OF SPECS, PLANS OR OTHER CHANGES	<input type="checkbox"/> VALUE ENGINEERING OR COST REDUCTION CHANGES

REMARKS: INCLUDE GAIN TO NAVY (Saving in cost or weight, safety of ship or personnel, increase reliability, improve operational characteristics necessary to permit ship to carry out mission, increase economy, improve habitability, etc.)

**Increase reliability and integrity of sea water systems.**

ACTION TAKEN TO INCORPORATE THE PROVISIONS OF THIS CHANGE IN GENERAL OR MIL SPECIFICATIONS OR SPECIAL OR DETAIL SPECIFICATIONS OF OTHER SHIPS BUILT OR CONTEMPLATED. INCLUDE ESTIMATED CHANGE IN WEIGHT OR MOMENT.

**Shown on contract guidance plans for SS(N)637 and SSB(N)640 Classes. ShipAlt to be issued for active nuclear submarines which will include ships of SS(N)593 and SSB(N)616 Classes in which the extensive vent system is already installed. Estimated weight, moment, and cost reduction for ships in which no vent piping is installed are 450 pounds, 6750 foot pounds, and \$5000, respectively, per ship.**

**See attached sheet.**

**\* - Change order will authorize omission of applicable constant vents on those ships where the status of construction is such that no cost or a reduced cost is obtained.**

SIGNATURE (Ship Branch Head)	CODE 448 APPROVAL (For any change that involves a change in weight or moment)
------------------------------	-------------------------------------------------------------------------------

A-20559

Copy to: :  
640 648C

EXHIBIT (167) - 1

J.Sinsabaugh, X61707; C.King, 4/12/63 C3-13

### Brief Resume

Elimination of the major portion of the constant vent system from nuclear submarines will permit obvious savings in space, weight, and maintenance. It will also improve the damage resistance of the ships by eliminating a large part or portion of internal sea water piping subject to submergence pressure and will greatly simplify the task of finding and isolating a source of flooding. There is a parallel capability, which will be retained, of manually venting components when necessary. Constant vents will be retained for main condensers, main air ejector condensers, main and auxiliary sea water cooling system pumps, and reactor plant FW/SW heat exchangers.

The change will also require, where not now installed, check valves at the continuous vent header overboards and at each connection to the vent header to prevent backflow from the header to a system which may have been secured for damage control purposes.

Also the installation of orifices will be required in the remaining vent lines to limit velocity to **b(3) 10 USC 130** to prevent erosion of pipe, valves, and fittings in these lines.

This change is based on the results of tests, conducted by two SS(N)'s and one SSB(N) at the request of the Bureau, wherein all sea water system constant vents (except those mentioned above) were secured for a period of at least 30 days. Only one instance of air binding occurred, which was not serious. The elimination of constant vents has been concurred with by the Type Commanders.

5

SCULPIN

590

SCULPIN

590

EXH 168

OFFICIAL U. S. NAVY PHOTO

Not for Publication

Unless Officially Released

NO. 1721 DATE 5 '63

UNIT ASG

MADE FOR

BY

OFFICIAL PHOTOGRAPH  
NOT TO BE RELEASED  
FOR PUBLICATION  
MADE IN THE U.S.A.

ULTRASONIC  
TEST  
Shows 10% Bond

22



EXH 169

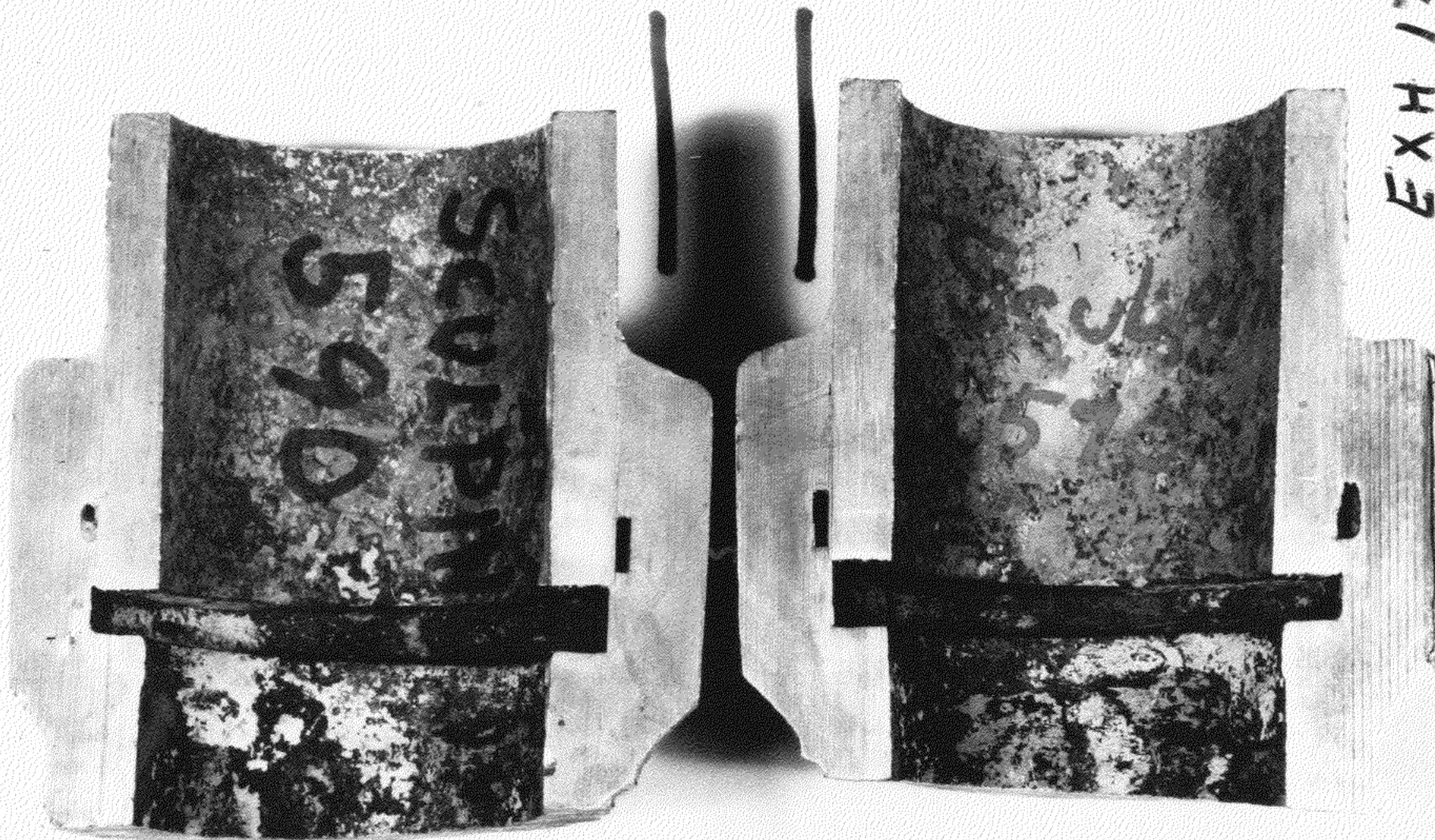
NO. 1722 DATE 5 '63

UNIT ASB

MADE FOR

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OFFICIAL PHOTOGRAPH  
NOT TO BE RELEASED  
FOR PUBLICATION  
NAVAL AIR FORCE PHOTOGRAPH



NO. 1723 DATE 5-63

UNIT ASB

MADE FOR

SIGNATURE



Unclassified

DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

C-SS(N)593  
Ser 525-076  
9 March 1962

CERTIFIED MAIL

From: Chief, Bureau of Ships  
To: Deputy Commander Submarine Force, U. S. Atlantic Fleet (5 copies)  
Assistant Industrial Manager, Groton (5 copies)  
Commander, Portsmouth Naval Shipyard (5 copies)

Subj: USS THRESHER (SS(N)593) shock tests, recommendations  
for pre-test shock hardening (U)

Ref: (a) DEPCOMSUBLANT conf INSTR 09110.6 of 2 Nov 61  
(NOTAL)  
(b) BUSHIPS spdltr SS(N)593C1/9010, ser 525-636  
of 23 Feb 62 (NOTAL)  
(c) BUSHIPS ltr C-SS(N)585 ser 525-068 of 23 Feb 62  
(NOTAL)

Encl: (5 copies to each addressee)  
(1) USS THRESHER - Applicable shock hardening items  
listed in encl (1) and (5) of DEPCOMSUBLANT INSTR  
09110.6  
(2) USS THRESHER - Applicable shock hardening items  
listed in encl (2) of DEPCOMSUBLANT INSTR 09110.6  
(3) USS THRESHER - Additional shock hardening items  
(4) USS THRESHER - Additional shock hardening measures  
by Ship's Force

1. This letter reviews shock hardening measures which should be accomplished in THRESHER prior to the planned shock tests, insofar as practicable. These measures are based primarily on analysis of the results of shock testing TROUT, SKATE, BONEFISH and SKIPJACK. Shock hardening in the reactor plant area is being covered in separate correspondence.

2. Reference (a) and enclosures thereto summarized action required to shock harden submarines based on the results of shock testing TROUT, SKATE, and BONEFISH. Checks, adjustments and corrections listed therein which are applicable to THRESHER and which can be effected by ship's force should be carried out prior to THRESHER shock tests, insofar as practicable.

3. Enclosure (1) lists shock hardening work which requires shipyard assistance to correct applicable items listed in enclosures (1) and (5) of reference (a). E. B. Division should accomplish those items for which Bureau funding is indicated. It is recommended that the Type Commander authorize and fund the remaining items as indicated.

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

EXH 171-1

Unclassified

Unclassified

C-SS(N)593  
Ser 525-076

4. Enclosure (2) lists applicable shock hardening items in enclosure (2) of reference (a) which Forces Afloat are correcting. These items are considered of sufficient importance to warrant shipyard accomplishment if forces afloat cannot complete before THRESHER shock tests. It is recommended that the Type Commander authorize and fund shipyard accomplishment of these items as necessary.
5. Enclosure (3) lists additional shock hardening items generated from a review of the preliminary reports of SKIPJACK shock tests and the use of new equipment not previously subjected to underway shock tests. E. B. Div. should accomplish those items for which Bureau funding is indicated. It is recommended that the Type Commander arrange for accomplishing and funding the remaining items as indicated.
6. Enclosure (4) lists shock hardening measures which ship's force should accomplish. Special attention should be given to these items. They result from derangements or damage occurring in the earlier submarines tested.
7. Bureau electronics engineers will visit THRESHER during the pre-test shock hardening availability. They will conduct an examination and check of electronic equipment similar to that carried out in SKIPJACK. Any corrective work not within the capability of ship's force will be considered for shipyard accomplishment in separate correspondence.
8. The Bureau desires to test the NAE Beacon Mark 2 Mod 4 in THRESHER for shock proofness. David Taylor Model Basin will furnish twelve beacons numbered 1 thru 12. These beacons will not contain any hazardous chemicals and will therefore present no hazard to ship or personnel. If possible, the shipyard should install these beacons as follows:
  - a. One beacon in each of the signal launching tubes in a position for launching.
  - b. Two beacons near each of the signal launching tubes in a normal standby position.
  - c. The remaining beacons in normal stowage position where convenient.

On completion of tests the beacons are to be returned to DATMOBAS for check and analysis of any damage. Shipyard work is to be funded by the Bureau.

Exh 134-2

Unclassified

C-SS(N)593  
Ser 525-076

9. In previous shock tests, breakage of plastic windows and plastic bubbles topside occurred. To eliminate unnecessary replacement expense it is recommended that ship's force remove the plastic wind shield topside and temporarily stow on shore or on board a tender.
10. Details of design changes should be prepared for any shock hardening modifications required. Three copies should be forwarded to the Bureau. Reference (b) assigned NAVSHIPYD Portsmouth the design work and provided funding for preparing or revising plans as necessary to accomplish shock hardening in THRESHER (except in the reactor plant area).
11. Funding for shock hardening work at E. B. Div. is being covered by separate correspondence.
12. Reference (c) authorized SUPSHIP Groton to establish a project with E. B. Div. to review and analyze shock damage resulting from SKIPJACK tests. It is the Bureau's intention that no duplication of shock hardening design effort occur between E. B. Div. and NAVSHIPYD Portsmouth. ADM Groton is requested to keep NAVSHIPYD Portsmouth informed of shock hardening design work being done by E. B. Div. that may also be applicable to THRESHER.
13. Additional shock hardening items for THRESHER as may be determined to be needed based on shipyard examination of SKIPJACK and on further developments will be covered in separate correspondence.

b(6)

Copy to: (w/encl)  
CNO (OP31)  
CNO (OP41)  
CINCLANTFLT  
COMSUBLANT  
COMSUBPAC  
BUWEP (RUSD-4) (3)  
NAVSHIPYD MARE (3)  
COMSUBRON TWELVE  
COMSUBDEVGRU TWO (2)  
CO USS THRESHER (SSN593) (3)  
CO USS SKIPJACK (SSN585)  
SUBASE NLOW  
DATMOBAS (3)  
E.B.DIV. (5)

W. D. ROSEBOROUGH  
By Direction

3

COWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY Unclassified 10

EXH 111-3

Unclassified

C-SS(N)593  
Ser 525-076

Copy to: (w/encl) (cont)

420  
430  
431 (2)  
423 (3)  
440  
450  
525A1A  
525B1a  
525AT  
525T (10)  
525P  
408  
695C (2)  
1500 (5)  
443  
622D  
603 (2)  
640B  
670 (2)  
630  
631M  
632 (2)  
633  
641 (2)  
644 (2)  
645  
648 (3)  
660 (3)  
665 (3)  
651  
649  
694 (2)  
660P  
525E2  
634  
687

(b) (6)

EXH 171-4

Unclassified

ENCLOSURE (1)

USS THRESHER (SSN593) - Applicable Shock  
Hardening Items Listed in Enclosure (1) and (5)  
of DEPCOMSUBLANT INSTR 09110.6

Ref: (a) BUSHIPS INSTR 9620.63 of 21 Oct 60, with Ch.  
No. 1 of 7 Feb 61  
(b) BUSHIPS spdltr C-9780 ser 603D-075 of 7 Feb 62  
(c) BUSHIPS INSTR 9490.12 of 15 Aug 61  
(d) BUSHIPS ltr ser 648M-258 of 7 Apr 61  
(e) NAVSHIPYD PTSMH ltr SS(N)593C1/9020/3, SS(N)593/  
9490/3(69319) of 16 Feb 62

b(1)

2. Correction of deficiencies in sil-brazed joints in piping systems. Sea water systems in THRESHER have welded joints from hull flange of hull valves through the inboard flange of back-up valves. There are no known deficiencies to sil-brazed joints.

The Bureau is planning to have International Inspection Inc. conduct ultrasonic inspection of sil-brazed joints in the main and vital hydraulic systems in THRESHER. This will be covered by separate letter. BUSHIPS will fund.

b(1)

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DDN DIR 5200.10

Unclassified

EXH 131-5

Unclassified

b(1)

After these shock tests the Westinghouse engineer will inspect and make adjustments and repairs as required. The shipyard should then re-install these two breakers. The Westinghouse engineer will make all adjustments to all the ACB breakers in THRESHER as deemed necessary based on the breaker shock tests. It is also planned to instrument selected ACB breakers to obtain performance data during the tests. BUSHIPS will fund.

b(1)

Type Commander should fund.

6. Shock hardening of fire control system. Since THRESHER has a Mk 113 F.C. System, this will be the first submarine to be shock tested with this system installed. Reference (b) requests BUWEPs to initiate shock hardening measures for the F.C. system in THRESHER as considered necessary.

b(1)

ENCL (1) to BUSHIPS SER 525-076 2

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 171-6

Unclassified

7. Replacement of existing gages with shock resistant type in critical systems. Preliminary SKIPJACK damage reports indicate several gages were damaged and others required recalibration. The shipyard should replace existing gages in THRESHER with shock proof gages as specified in reference (d). BUSHIPS will fund.

Ship's force should insure that remaining gages have plastic faces in lieu of glass. Type Commander should fund.

8. Minimization of entrance of foreign matter into periscope. Foreign matter deposited on the optics of the 8B periscope during SKIPJACK tests. However, disassembly of the 8B periscope in THRESHER prior to the shock tests for close inspection and cleaning is not planned.

b(1)

3 ENCL (1) to BUSHIPS SER 525-076

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 171-7

Unclassified

Ship's force should insure that valves in tubular type sight gage lines (except where gages are fitted with plastic tubing) are closed during the shots to prevent loss of fluid if breakage occurs. This should include closing the valves on the upper and lower ends of the sight gages for the main and vital and the external hydraulic oil supply tanks. Taping of gages having glass tubes to protect personnel from shattering glass is also recommended.

b(1)

ENCL (1) to BUSHIPS SER 525-076 4

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 131-8

Unclassified

ENCLOSURE (2)

USS THRESHER (SSN593) - Applicable Shock  
Hardening Items Listed in Encl (2) of  
DEPCOMSUBLANT INSTR 09110.6

Ref: (a) BUSHIPS ltr ser 648D2-1393 of 11 July 60

b(1)

7

ENCL (2) to BUSHIPS SER 525-076

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 174-9

Unclassified

ENCLOSURE (3)

USS THRESHER (SSN593) - Additional  
Shock Hardening Items Resulting from  
SKIPJACK Tests and Use of New Equipment

1. HY-80 hull surveillance inspection. The shipyard should conduct a normal six month interval hull surveillance inspection in accordance with BUSHIPS Instruction 9110.48 of 13 Sept 60. In addition to priorities 1 thru 5 that constitute the normal six month inspection, the following areas should be given a magnetic particle inspection

- a. Escape trunk, frame 19 (priority 6 in BUSHIPS INSTR)
- b. Torpedo tube penetration (priority 7 in BUSHIPS INSTR)
- c. Transverse frame 79 (priority 12 in BUSHIPS INSTR)
- d. b(1)

BUSHIPS will fund.

2. SSTG sets. These have separate motor driven lube oil pumps. b(1)

Air  
driven lube oil pumps should be installed in THRESHER for coast down purposes in accordance with change order no. 191.1 for SSN593 Class. BUSHIPS will fund.

b(1)

A Bureau engineer will install and check the trigger and trip rod mechanism. Also under consideration is the installation of a valve to permit by-passing the overspeed tripping device if it should be damaged.

3. Propulsion turbines. The overspeed trips will be checked by a Bureau engineer.

The side flex plates on the propulsion turbines appear to be questionable with regard to shock resistance. Means to detect yielding will be provided by DATMOBAS and Bureau representatives.

4. Conolog installation. The conolog equipment should be removed from its skids and a permanent type installation made by the shipyard. NAVSHIPYD Portsmouth should determine the need for providing protection against shock damage. BUSHIPS will fund.

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED AND NOT FOR EXPORT  
Unclassified

EXH 171-10

Unclassified

b(1)

ENCL (3) to BUSHIPS SER 525-076 2

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 151-11

Unclassified

10. NAVSHIPYD Portsmouth should investigate the cantilever mounting of the trash ejector and determine means for supporting the ejector at the breech end. E.B. Div. should accomplish modifications as may be needed. BUSHIPS will fund.

11. NAVSHIPYD Portsmouth should check the mounting flange bolt strength of the stern diving and steering rams for adequate resistance to shifting under shock. E.B. Div. should accomplish modifications as may be needed. BUSHIPS will fund.

K? 12. NAVSHIPYD Portsmouth should review the casualties which occurred to main ballast tank vent valves in BONEFISH and SKATE shock tests to determine the need for design changes in THRESHER. Recommendations should be forwarded to the Bureau.

13. NAVSHIPYD Portsmouth shall insure that adequate design work is completed to permit maximum shock hardening of the main feed pump controllers. Portsmouth shall make maximum use of E. B. Division investigation of controller tripping problem in SKIPJACK. E. B. Division should accomplish modifications as may be needed. Recommendations should be forwarded to the Bureau. BUSHIPS will fund.

3

ENCL (3) to BUSHIPS SER 525-076

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 171-12

Unclassified

ENCLOSURE (4)

USS THRESHER (SSN593) - Additional  
Shock Hardening Measures by Ship's Force

Ref: (a) BUSHIPS ltr ser 648D2-658 of 24 Mar 61

- K → 1. Check tightness of valve bonnet bolts, pipe flange bolts, union nuts, pipe hanger bolts.
- K → 2. Check tightness of bolts on sea valves and back-up valves.
- 3. Check tightness of hold down bolts and blower pump mounting bolts for emergency diesel generator set.
4. In electronic equipment, insure that clamps for tubes, relays, etc are tight and are installed where required. Provide and install ruggedized tubes, where available.
5. Properly secure stowed parts.
6. Insure that lamp locks are installed in all fluorescent light fixtures.
7. Drawers in electrical and electronic consoles should be secured in place and checked for tightness.
8. Insure that controllers and associated control circuits for motor operated auxiliaries are in good operating condition and that electrical connections are tight.
9. Insure that fuses in d-c power supplies have fuse retainers installed.
10. In switch boards and group control units, wiring connections should be checked for tightness and all loose bolts, nuts and washers which may have been left inside during construction should be removed.
11. Insure that relay retainer plates in LMC and TMC equipment are installed and that securing screws and nuts are tight.
12. Insure that electrical wiring to terminals does not have lengths of exposed bare copper wire which may cause shorts or grounds during shock impacts. Provide taping or suitable bracing.

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED Unclassified DDN DTR 5000 10

EXH 104-13

Unclassified

13. Insure that relief valves at all high pressure reducing station outlets are reset in accordance with reference (a). E

14. Insure that messenger buoys are properly secured in place.

15. Insure that main ballast tank vent base plate bolts are tight.

16. Ventilation terminals should be inspected. Worn Type E terminals and commercial diffusing terminals which disengage if turned about 1/4 or 1/2 a turn may become missiles during shock. Such terminals should be replaced or adequately secured to prevent damage to other equipment or personnel.

17. Check machinery and equipment foundation support bolts and screws. Install locknuts or other similar locking devices where not provided. Spring lock washers and similar items which lose their effectiveness if the bolt or screw stretches are not suitable and should not be used. Tighten bolts and screws evenly, using torque indicating wrenches if available.

18. Check under water log Twinax cables to insure that the locking sleeves are hand tight.

19. Insure that retainers or lock-in devices for connecting cables plugs used with I.C. and other electric equipment are installed and tight.

20. Although no difficulties are expected to occur to the main shaft Sealol seals, the flax packing should be checked and in condition for immediate use, if required.

21. After each shot the main thrust bearing should be carefully observed. Thrust bearing end clearance may increase and the astern bearing may deform somewhat. Thrust bearing hold-down bolts may stretch or deform. To assist in checking, the following instrumentation is available in the ship:

- a. A dial indicator on top of the thrust bearing which reads shaft motion.
- b. Strain gage meters in Maneuvering Space which read shaft motion.
- c. Accelerometer meter in Maneuvering Space which reads thrust bearing and hull motion.

22. Prior to each shot insure that the detents for the 8B periscope eye piece are tightened to maximum spring compression.

ENCL (4) to BUSHIPS SER 525-076

2

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED

Unclassified

EXH 134-14

Unclassified

23. Check the propeller shaft tachometer as per maintenance instructions in the technical manual. Special attention should be given to the slip clutch and associated contacts.

24. Secure the depth detector amphenol connector on the servo amplifier with an additional metal strap. This connector separated during SKIPJACK tests.

25. Check all sea connections of depth gages for proper tightness. A connection to a shallow depth gage loosened in SKIPJACK.

26. All personnel on board during the shots should be alerted against coming in contact with phosphate ester fluid or breathing its vapors in the event of leakage in the hydraulic system.

3 ENCL (4) to BUSHIPS SER 525-076

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

Unclassified

EXH 171-15

M E S S A G E

152242Z SEP 1961

FM BUSHIPS  
TO DEPCOMSUBLANT

INFO CNO  
CINCLANTFLT  
COMSUBLANT  
COMSUBPAC

UNCLAS  
SUBMARINE SALT WATER PIPING SYSTEMS

A. DEPCOMSUBLANT MSG 131410Z of SEP

1. DEPCOMSUBLANT HAS OUTLINED A MOST SERIOUS PROBLEM IN REF A. BUSHIPS WILL CONTINUE, AT HIGHEST PRIORITY, TO SEEK ADDED DEPENDABILITY IN SUBMARINE SALT WATER PIPING SYSTEMS. SPECIFIC CORRECTIVE ACTION HAS BEEN TAKEN BASED ON FAILURES LISTED PARA 2 AND 3 REF A.

2. DEPCOMSUBLANT IS AWARE OF THE ACTION TAKEN BY BUSHIPS TO DATE TO IMPROVE QUALITY CONTROL IN SUBJECT SYSTEMS. WITH REGARD TO RECOMMENDATIONS OF REF A PARA 4 THE FOLLOWING COMMENTS ARE SUBMITTED:

A. IN EARLY 1961 EACH SUBMARINE BUILDER WAS VISITED AND PROVIDED INSTRUCTIONS TO IMPROVE QUALITY CONTROL. ON 31 AUG 1961 ALL BUILDERS WERE CALLED TO BUSHIPS TO REEMPHASIZE IMPORTANCE OF OBTAINING HIGHEST DEGREE OF RELIABILITY, REPORT PROGRESS, AND DISCUSS TECHNIQUES TO FURTHER IMPROVE QUALITY IN SUBMARINE SEA WATER SYSTEMS.

B. STANDARD PLANS HAVE BEEN ISSUED TO ELIMINATE KNOWN DESIGN DEFICIENCIES IN BOSSES. OTHER CONNECTIONS HAVE BEEN INVESTIGATED AND THERE ARE NO OTHER KNOWN IMPROPER DESIGNS APPROVED FOR SUBMARINE INSTALLATION.

C. BUSHIPS MSG 012214Z and 012213Z OF SEP REFER. FURTHER INSTRUCTIONS WILL BE PROMULGATED UPON COMPLETION INVESTIGATIONS.

D. ULTRASONIC TEST PROCEDURES ARE NOW RECEIVING SHIPBOARD EVALUATION AT NAVSHIPYD MARE. EBDIV IS UNDER CONTRACT TO DEVELOP ACCEPTANCE STANDARDS. DEFINITIVE TECHNIQUES ARE EXPECTED TO BE AVAILABLE IN JAN 1962.

E. SPECIFICATIONS FOR BUILDING SUBMARINES CONTAINED DEFINITIVE REQUIREMENTS RESTRICTING THE PROXIMITY OF PIPING AND PIPE JOINTS, RELATIVE TO ELECTRICAL, ELECTRONICS, FIRE CONTROL EQUIPMENT, ETC., WHEREVER A SHORT CIRCUIT, FIRE HAZARD, DAMAGE TO EQUIPMENT, OR INJURY TO PERSONNEL COULD OCCUR. IN ADDITION, A CONTRACT HAS BEEN LET FOR IMPROVEMENT IN FUTURE SSBN DESIGN SPECIFICALLY AIMED AT SIMPLIFYING PIPING SYSTEMS TO REDUCE THE NUMBER OF JOINTS AND IMPROVE RELIABILITY. BUSHIPS HAS INCLUDED A DUAL BID INVITATION FOR FY62 SS(N)593 CL TO OBTAIN COST DATA AND TECHNICAL FEASIBILITY OF AN ALL-WELDED VICE SIL-BRAZE

EX 172-1

152242Z SEP 1961  
(cont'd)

SALT WATER SYSTEMS.

4. BUSHIPS WILL CONTINUE DELIBERATE PURSUIT OF TECHNIQUES AND PROCEDURES TO IMPROVE QUALITY OF DESIGN AND WORKMANSHIP IN SUBMARINE SEA WATER SYSTEMS. BUSHIPS WILL RE-EMPHASIZE TO ALL SUBMARINE CONSTRUCTION AND REPAIR ACTIVITIES THE SERIOUSNESS OF THIS EFFORT. IN ADDITION EACH ACTIVITY WILL BE RE-INSPECTED TO DETERMINE THAT PROPER QUALITY CONTROL AND INSPECTION TECHNIQUES ARE IN USE AND THAT WORKMEN ARE PROPERLY QUALIFIED.

5. THE ABILITY TO CONTAIN THESE CASUALTIES DEMONSTRATED SO EFFECTIVELY TO DATE IS A CREDIT TO THE OPERATING FORCES AND MUST NEVER BE NEGLECTED.

The Self-Contained Specifications for Building Submarine SS(N) 593, Section S62-1, Page 583, lines 51 through 87, reads as follows:

b(1)

**EX173**

b(1)

1761-63

NO. \_\_\_\_\_ DATE \_\_\_\_\_

UNIT *ASB* \_\_\_\_\_

MADE FOR \_\_\_\_\_

SUBJECT \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**b(1)**

U.S. 1763-68 DATE

UNIT *ASB*

MADE FOR

SUBJECT

u(1)

1767

NO. 1767-68 DATE

UNIT ASB

MADE FOR

SEQUENT

د(1)

NO. 1768-63 DATE

UNIT ASB

MADE FOR

SUBJECT

b(1)

NO. 1762-68 DATE

UNIT ASB

MADE FOR

SUBJECT

b(1)



10. **1766-63** **DATE** .....

**UNIT** *ASB* .....

**MADE FOR** .....

**SUBJECT** .....

.....

(1)

40. 1764 -63 DATE

UNIT ASB

MADE FOR

SUBJECT



NO. 1765-68 DATE \_\_\_\_\_  
UNIT ASB \_\_\_\_\_  
MADE FOR \_\_\_\_\_  
SUBJECT \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SHIPBOARD TEST MEMORANDUM  
8-PMS-1050 (Rev. 3-58)

NO.	SS(N)593-S08 01 006	REV.	A
PLANNED DATE OF TEST		ISSUE DATE	

TEST PLANNING

VESSEL APPLICATION  
**SS(N)593**

TITLE  
**BLOWING MAIN BALLAST TANKS**

PREPARED BY **b(6)**

CHECKED BY

SECTION NO.

REVIEWER	<b>b(6)</b>
TEST ENGINEER	<b>b(6)</b>

REVISIONS							
SYM.	REVISION	APP'D.	DATE	SYM.	REVISION	APP'D.	DATE
A	3 WEEK REVIEW	<i>[Signature]</i>	12/28				

ISSUE RECORDS																					J.O. NUMBER	ESTIMATOR	
DATE	REV.	803	X56	X51	X28	PFE			911A	308A	CHASIN	MARE	ED	INGAL	NYSD	PDP	9078	308	511	20TT	246S		
		10	12	4	3				1	1	1	1	1	1	1	2	1	1	1	1	1	1093-1-5731	SW
A		15	12	4	10	2			1	1	1	1	1	1	2	1	1	1	1	1	1	5731	

For additional copies of this document contact Code 5 Ext. 600

TEST PERFORMANCE			
FUNCTION	ASSIGNMENT	COMPLETION	
		SIGNATURE	DATE
SYSTEM READINESS KEY SHOP			
TEST PREPARATION			
TEST SUPERVISOR	<b>b(6)</b>		
TEST ENGINEER			5/31/61
CONTRACTOR OR VENDOR WITNESS			

APPROVAL OF RESULTS

**b(3) 10 USC 130**

ASW Pumps became air bound during  
Air Binding Check Considered satisfactory for  
normal blowing operations.

TEST SUPERINTENDENT	DATE	TEST COORDINATOR
---------------------	------	------------------

## BLOWING MAIN BALLAST TANKS

### 1. REFERENCES

- 1.1 BuShips Dwg No. 1862812, High Pressure Air System, Main Ballast Tank Blow System Diagram

### 2. EQUIPMENT REQUIRED

- 2.1 A watch with a second hand

### 4. TESTS

#### 4.1 Operation

##### 4.1.1 Main Ballast Blow System Operation

Starting with the vessel submerged at approximately <sup>60</sup>~~50~~ feet depth, and stationary in the water, blow selected main ballast tanks dry using the main ballast blow system.

NOTE: Selected main ballast tanks may be interpreted to mean all main ballast tanks at the discretion of the ballast control officer. Record the following data:

Tanks blown ALL MBT

Time from start 0 minutes, 54 seconds

Air Banks used: Nos 2 & 3

Bank pressures before blowing: No. 2 ~~PSI~~ <sup>b(1)</sup>

No. 3 ~~PSI~~

Bank pressures after blowing: No. 2 ~~PSI~~

No. 3 ~~PSI~~

Rate of surfacing: .5 feet per second

Maximum trim angle while surfacing: Rise - 5 Deg.

Blowing Time - 34 seconds.

##### 4.1.2 L.P. Blow System Operation

4.1.2.1 Upon emergence from a submerged run the ballast control officer shall acquire and maintain zero trim and neutral buoyancy.

4.1.2.2 With only the negative tank empty, blow all out residual water from the main ballast tanks using the Low Pressure Blow System. A bridge watch shall notify the maneuvering room when bubbles appear from each tank. Record requested data in Table No. I every thirty seconds for a period of 30 minutes and in Table No. II when bubbles appear from each tank.

NOTE: The ship should be nearly stationary in water at the end of the blowing period for most accurate observation of bubbles from each tank.

TABLE I

Time Elapsed	Blower Disch, PSI	Keel Depth, Ft.	Time Elapsed	Blower Disch, PSI	Keel Depth, Ft.
0	7	37	15	11.5	26--
30	7	36	15-30	14.7 Note	26
1-00	5	31	16	14.7 #1	26
1-30	5	31	16-30	14.7	26
2-	5	31	17	12 Note	26
2-30	5.5	30.5	17-30	12 #2	26
3	5.5	30			
3-30	5.5	30			
4	6	29			
4-30	6.5	29			
5	6.5	28.5			
5-30	7	28.5	Note #1 -	Fwd Group Blow	
6	8	28.5		Secured	
6-30	8	28.5			
7	8	28			
7-30	8	28	Note #2 -	Fwd Group Blowing	
8	8.5	28			
8-30	8.5	28			
9	8.5	28			
9-30	9	28			
10	9.5	28			
10-30	9.5	28			
11	9.5	27.5			
11-30	10	27.5			
12	10	27.5			
12-30	10.5	27			
13	10.5	27			
13-30	11	26.5			
14	11	26.5			
14-30	11	26.5			

TABLE II

MBT NO.	Time to Blow	
	Minutes	Seconds
1	<u>15</u>	<u>0</u>
2	<u>15</u>	<u>0</u>
3	<u>15</u>	<u>0</u>
4	<u>17</u>	<u>30</u>
5	<u>17</u>	<u>30</u>
6	<u>17</u>	<u>30</u>
7	<u>17</u>	<u>30</u>

## 4.1.3 Air Bind Check

Upon emergence from a submerged run, with the vessel proceeding ahead at a speed between 5 and 8 knots, blow all main ballast tanks using the LP Blow System. Check for air binding in the vessels sea water circulating systems during and after blowing tanks. Record data below. For performance, note "No Affect", "Pressure Fluctuating", or "Pump Air Bound". If a pump becomes air bound, record the time, in seconds, from the beginning of air binding until the pump frees itself of air. For satisfactory operation, pumps must free themselves of air in sufficient time to prevent any noticeable change in system performance.

Time to blow tanks: 17 Min. 30 Sec.

SW Sytem	Performance
Main Condenser S.W.	<u>No Affect</u>
Aux S.W. Cooling	<u>Air Bound</u> *
Air Cond S.W.	<u>Press. Fluctuating</u>
Diesel Gen. S.W.	<u>No Affect</u>
	Satisfactory <u>                    </u>

\* b(3) 10 US A.S.W. pumps became Air bound at 3 knots. Did not free itself Air vented off  
 b(3) 10 I was satisfactory after 3.5 min. Became Air Bound again when ship speed reached 10 knots.

b(1)

b(1)

NR50  
SXC132  
CTA202  
MM RUEGXC  
DE RBEPD 215  
ZNR

RBATC T NAVREPFAC YOKOSUKA  
RBMFA T NAVREPFAC SUBIC  
M 152241Z

FM BUSHIPS  
TO NAVSHIPYD PTSMH  
NAVSHIPYD PHILA  
NAVSHIPYD NORVA  
NAVSHIPYD CHASN  
NAVSHIPYD SFRAN  
NAVSHIPYD MARE  
NAVSHIPYD PEARL  
NAVREPFAC SDIEGO  
NAVREPFAC YOKOSUKA  
NAVREPFAC SUBIC  
NAVREPFAC GUAM  
NAVSTA KWEST  
SUBASE NLON  
SUBASE PEARL  
INFO DEPCOMSUBLANT  
COMSUBLANT  
COMSUBPAC  
CNO  
CINCLANFLT  
BT

UNCLAS

SUBMARINE SALT WATER SYSTEMS

A. BUSHIPS LTR SER 525-1175 OF 29 MAY 1961

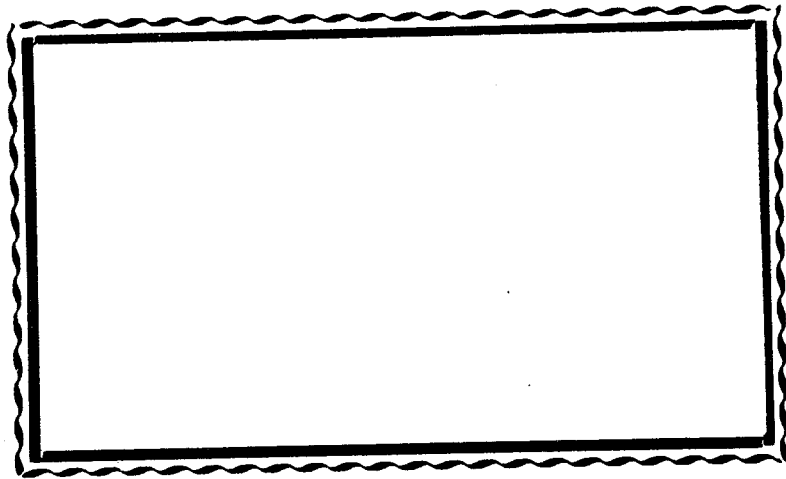
1. RECENT FLOODINGS OF SUBMARINES DUE TO FAILURES IN SALT WATER SYSTEMS DURING BUILDERS TRIALS IS A MATTER OF GRAVE CONCERN TO THE CHIEF, BUSHIPS. REF A REQUESTED A REVIEW OF CURRENT PRACTICES DIRECTED TOWARD IMPROVING STANDARDS OF WORKMANSHIP T ISSUE HIGHEST QUALITY SIL-BRAZED JOINTS.

2. THE CHIEF, BUSHIPS REEMPHASIZES THE SERIOUSNESS OF THIS PROBLEM AND DIRECTS THAT ALL SUBMARINE REPAIR ACTIVITIES TAKE IMMEDIATE POSITIVE ACTION TO IMPLEMENT ALL PREVIOUS DIRECTIVES TO IMPROVE QUALITY OF DESIGN AND WORKMANSHIP

BT

15/2304Z





Materials Testing Laboratory  
Portsmouth Naval Shipyard  
Portsmouth, New Hampshire

EXH 179



6/2/61

SEA WATER PIPING, SS(N) 593  
FAILURE OF SILVER-BRAZED JOINTS

Exh 179-2

### SUMMARY

The partial rupture of the 4" silver-brazed joint in the slip fitting is attributed to two conditions:

- (1) insufficient bonding of the pipe to the fitting, and
- (2) stresses within the joint which exceeded the design criteria during operational sea trial testing.

### REFERENCES

- (a) Brochure, "Silver-Brazed Sea Water Systems in Submarines", dated 1 March 1961

### ENCLOSURES

- (1) Photograph illustrating section of pipe that ruptured
- (2) Photograph illustrating section of pipe that held
- (3) Photographs of joint illustrating bonded areas
- (4) Prints of radiographs: Fig.1, taken in area that failed in service; Fig.2, taken in area that held
- (5) Photograph of 3/4 IPS Union (TD)P-2/F-96 in priming line that ruptured during sea trials.  
(No examination could be made as this joint was repaired at sea. Chemical analysis of union is contained herein).

### BACKGROUND

Failure of joints in the trim system was discovered during the second sea trial of the SS(N) 593 (THRESHER). The two joints that failed were:

(a) 3/4" union tail, piece F-96, which was brazed into a boss on (TD)P-2 on drawing 1862887.

(b) 4" slip coupling, piece F-83 in (TD)P-2 on drawing 1862886.

It appears that failure was a result of cycling the trim suction hull back-up valve, TD-2. With TD-1 open and TD-6, 14, 15, and 16 shut, TD-2 was cycled. This valve was cycled at 100' increments until test depth was reached. With each cycle, full sea pressure was imposed on the trim suction main which was at or below atmospheric pressure inducing violent water hammer. There is no definite knowledge or evidence that both joints failed at the last impulse. It is evident, however, that the system was exposed to abnormal pressures since the adjacent pipe bulged to approximately 0.070 inch above the maximum allowable diameter of the pipe specification.

## METHOD AND RESULTS OF TESTS

### X-RAY EXAMINATION.

The 4" pipe joint was X-rayed prior to sectioning. The prints illustrated in enclosure (4) indicate the following:

- (a) The insert was completely melted as illustrated in Fig.1, and partially melted as illustrated in Fig.2.
- (b) The flow of the silver alloy in the joint can be noted in Fig.1. (This is the area that ruptured while undergoing sea trials).

### METAL ANALYSIS.

	<u>FITTING F83</u> <u>4" Slip Coupling</u>	<u>PIPE</u> <u>4" IPS</u>	<u>UNION</u> <u>3/4" IPS</u>
%Copper.....	31.25	68.61	29.49
%Nickel.....	66.63	29.88	67.92
%Manganese.....	0.82	0.75	0.75
%Iron.....	0.98	0.66	1.48
%Silicon.....	0.15	0.06	0.17
%Carbon.....	0.16	0.04	0.18
%Sulfur.....	0.007	0.004	0.012
%Aluminum.....	None	None	None
IDENTIFICATION...	Nickel Copper	Copper Nickel	Nickel Copper

The silver alloy used in the 4" joints was identified as Grade IV in the insert, and Grade III in the fillet or external seal.

The above materials conform to plan requirements except that Grade III silver alloy is not prescribed or approved for use with Nickel-Copper.

TEST AND VISUAL EXAMINATION OF 4" PIPE JOINT.

A strength test was conducted of that portion of the pipe (approximately 1/3 the circumference) that showed no visual failure. This was accomplished by first sawing away that part which had failed and loading the remainder of the joint to the calculated design stress of 13,000 PSI. The area was 1 sq.in. The load was calculated to be 13,000 pounds. This section of the joint withstood the applied load satisfactorily without shearing or cracking.

The assembly was then heated to 1000°F and the pipe pressed from the fitting to reveal the percentage bond.

As shown in enclosure (3), there appears to be approximately a 20% bond in that area of the joint that parted, and approximately 30% in the section that was separated in the Laboratory--making a total over-all bonded area of 25%.

It has been shown by tests in reference (a) that the load to rupture a joint having a 25% bond is approximately 6,000 lbs. per inch, while the design criteria of a 4" pipe requires it meet 4,400 lbs. per inch. If these observations are correct, the joint should not have failed in the absence of shock.

### CONCLUSIONS

1. The 4" pipe assembly employed the proper materials except that the outer seal or fillet was made with Grade III silver alloy.
2. The joint is unsatisfactory by present standards because of the low percentage bond (approximately 25%).
3. The 3/4" joint was reported by those who witnessed it as a poor joint. (On follow vessels this joint will be changed from brazed to welded).

### DISCUSSION

The 4" joint, although submarginal by latest standards, is considered to have been adequate for service intended. Failure was the result of pressure surge induced by rapid opening of TD-2 at test depth.

On THRESHER, Valve TD-2 will be equipped with a pressure switch to prevent opening at depth below 100 feet. The hydraulic circuit to operate on TD6 will be equipped with a flow control check valve to permit slow opening time (approximately 7 secs.), and rapid closing time (1-2 secs.).



Photograph of 4" pipe showing a view of the area in which pipe separated from fitting.

Exh 179-8 ENCLOSURE (1)

Released

NO. 1768<sup>9</sup>-63 DATE \_\_\_\_\_  
UNIT ASB \_\_\_\_\_  
MADE FOR \_\_\_\_\_  
SUBJECT \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



Photograph of 4" pipe showing a view of the area of pipe that held.

Exh 179-9 ENCLOSURE (2)

Released

NO. 1773-68 DATE \_\_\_\_\_  
UNIT ASD \_\_\_\_\_  
MADE FOR \_\_\_\_\_  
SUBJECT \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PHOTOGRAPHS ILLUSTRATING BONDED AREAS



Fig. 1-Section of pipe joint which held during initial failure at sea.



Fig. 2-Section of fitting conforming to area shown in Fig. 1.

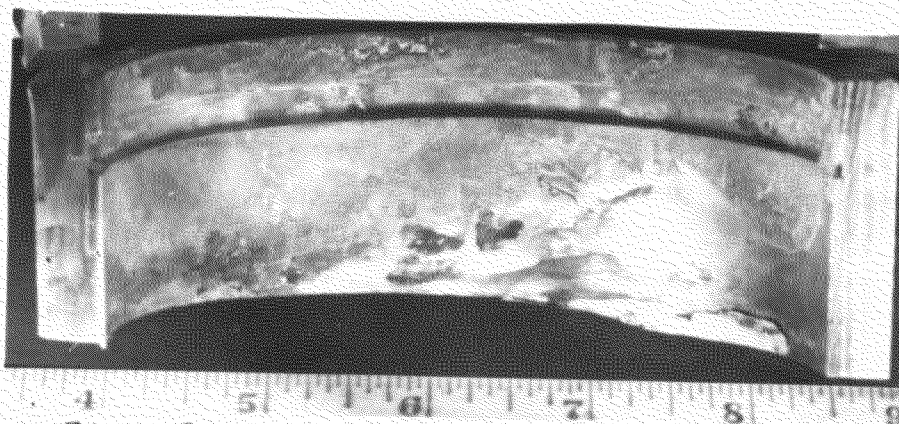


Fig. 3-Section of fitting illustrating that part of the joint that ruptured at sea.

Exh 179-10 ENCLOSURE (3)

Released

1770-68

NO.

DATE

UNIT

ASB

MADE FOR

SUPPLY



Fig.1-Photographic print of radiograph taken in area that failed in service, illustrating complete melting and flow of the insert ring. Silver alloy can also be detected by the mottled appearance.

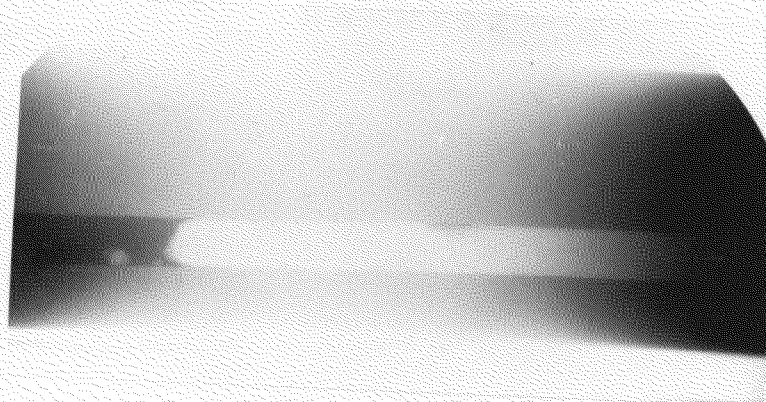


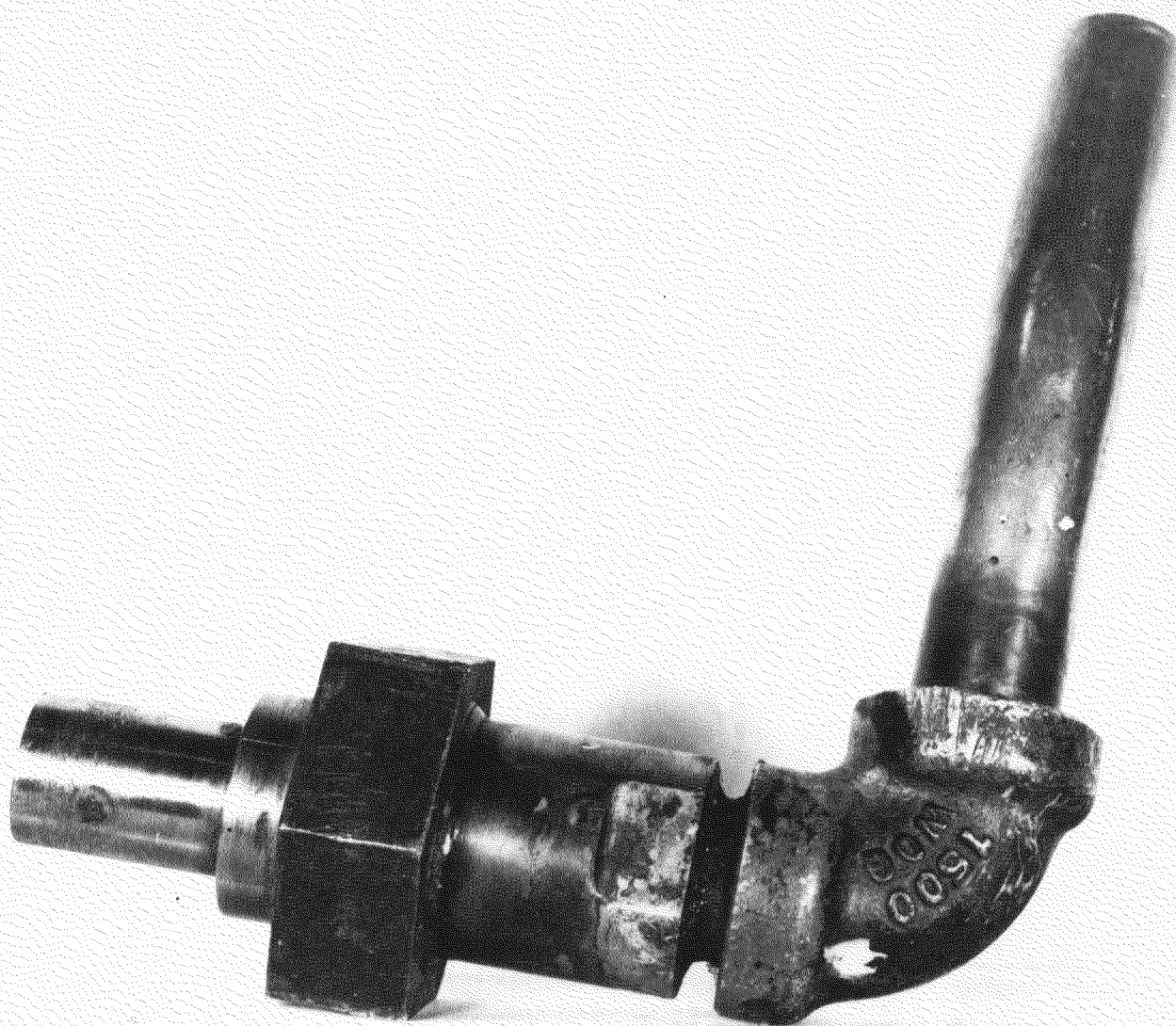
Fig.2-Photographic print of radiograph taken in area that held. The presence of solder in groove is noted.

ENCLOSURE (4)

Exh 179-11

Released

NO. **1772-63** DATE \_\_\_\_\_  
UNIT **ASB** \_\_\_\_\_  
\_\_\_\_\_  
MADE FOR \_\_\_\_\_  
SUBJECT \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



Photograph of 3/4" IPS Nickel-Copper Union that ruptured at sea.

Exh 159-12

ENCLOSURE (5)

Released

NO. 1771-68 DATE

UNIT ASB

NAME FOR

SIGNATURE

DATE

# JOB ORDER

IND-PNS-1714 (REV. 4-62)

b (6)

SCHEDULER	CODE	PLANNER	CODE	SHIP ACTIVITY	JOB ORDER NUMBER
	377D	b (6)	2BD	SS(N) 593	15-930-90393
DATE SCHEDULED	PHONE	DATE PREPARED	PHONE		
9-25-62	1363	9-21-62	206		MIP
AUTHORITY				P & E SUPVR. (UNIT CODE DATE)	TYPE DESK (UNIT CODE DATE)
W/L ITEM N-116				W/L 2B 9-21	16 2131 9-24-62
JOB TITLE					
VISUAL & ULTRASONIC INSPECTION OF SEA WATER SYS.					

WORK DESCRIPTION							
KEY OP	KEY SHOP WORK CTR.	ASST SHOP WORK CTR.	ESTIMATED MAN HOURS		SCHEDULE DATES		REF.
			ALLOW	TYPE	START	COMPLETE	
							(A) MAIN SEA WATER - 1862579-J
							(B) ASW SYS. (AFT) - 1862582-G
							(C) ASW SYS. (FWD) - 1862745-D
							(D) F.O. & COMP. WATER - 1862803-H
							(E) DIESEL GEN. S.W. COOL. - 1862588-F
							(F) TRIM & DRAIN SYS. - 1862774-J
							(G) A.C. S.W. COOL. - 1862711-J
							(H) 8000 G.P.D. - S.W. - 1862889-N
							(J) PLUMBING SYS. - 1862757-H
							(K) L.O. FILL & TRANS. - 1862626-J
							(L) PRESSURE SCHEDULE - 1862944-F
							(M) NAVSHIPS 250-648-8
01	3200		1280	A	10-1-62	11-16-62	VISUALLY INSPECT, PER SECTION 3b OF REF. (M), AND ULTRASONICALLY INSPECT ALL SILVER BRAZED JOINTS TWO INCHES AND ABOVE ON ALL PIPING SYS. REF. (A) TO (K) THAT ARE SUBJECTED TO SEA PRESS- URE. A MAN WILL BE ASSIGNED TO THE INSPECTION CREW TO SERIALIZE JOINTS FOR IDENT- IFICATION AND RECORDING PURPOSES. CHECK FIRST, THOSE JOINTS IN THE SYS. THAT ARE <u>NOT</u> LAGGED. IF, AT A LATER DATE, TIME ALLOWS. JMM

DISTR	PRODUCTION DEPT.			STRUCT.		OUTFG	ELEC.	MECHANICAL			SERVICE		NUCL. PWR.	PLANNING SUPPLY & COMPTROLLER DEP									
	303C	303D	340	11	17	38	51	06	31	37	64	71	2302	63	2344	227	228	229	231	232	233	240	251
35	340A	376	377	23	26	56	67	81	94		72	99	2306	66	245A	239	507	609	565	650			613
WORK COMPLETED				DATE			LABOR (DOLLARS)				OVERHEAD (DOLLARS)				MATERIAL (DOLLARS)				TOTAL (DOLLARS)				
															100.								

EXH 180-

IND-PNS-1714A (REV. 4-62)

JOB TITLE  
VISUAL & ULTRASONIC INSPECTION OF SEA WATER SYS.

Exh 180-1a SHEET 2 OF 2

# JOB ORDER

IND-PNS-1714 (REV. 4-62)

SCHEDULER b (6)	CODE 377	PLANNER b (6)	CODE 2BD	SHIP ACTIVITY SS(N) 593	JOB ORDER NUMBER 15-930-90393
DATE SCHEDULED 10-19-62	PHONE 1363	DATE PREPARED 10-17-62	PHONE 206		
AUTHORITY W/L ITEM N-116				P & E SUPVR. (UNIT CODE DATE) C.A. 2B 10-18	TYPE DESK (UNIT CODE DATE) JMB 213 10/19/62
JOB TITLE VISUAL & U.T. INSPECTION OF SEA WATER SYS 10-19-62					

WORK DESCRIPTION								REF.
KEY OP	KEY SHOP WORK CTR.	ASST SHOP WORK CTR.	ESTIMATED MAN HOURS		SCHEDULE DATES		(A) D.L.I. #15263 (B) 1862776-K (NO MS)	
			ALLOW	TYPE	START	COMPLETE		
02	5606		48	A	10-26-62	11-9-62	IN ACCORDANCE WITH REF. (A) REMOVE AND REPLACE THE FOLLOWING FITTINGS SHOWN ON REF. (B) F-9-1 & F-9-2 ON P-38 F-19-1 ON P-33-1 F-7-2 ON P-36-1 SOURCE OF NEW FITTINGS WILL BE SS/SG (2) <sup>b(3) 1</sup> 90° ELLS - (1385766) 44-30-289-8472 (1) 90° ELLS - (1385766) 44-30-289-8474 (1) TEE - SILS (1385766) 44-30-542-4366	A, B
NOTE: THIS IS TO COVER REJECTED JOINTS R-1, R-2, R-7 AND R-8.								

DISTR. 35	PRODUCTION DEPT.		STRUCT.	OUTPS	ELEC.	MECHANICAL		SERVICE	NUCL. PWR.	PLANNING SUPPLY & COMPTROLLER DEP											
	303C	303D	340	11	17	38	51	06	31	37	64	71	2302	63	2344B	227	228	229	231	232	233
	340A	376	377	23	26	36	67	81	94	72	99	2306	66	245A	239	507	609	565	650		
WORK COMPLETED			DATE		LABOR (DOLLARS)				OVERHEAD (DOLLARS)				MATERIAL (DOLLARS)				TOTAL (DOLLARS)				
													50-								

SHEET 1 OF 1

Exh 180-2

## IND-PNS-1714 (REV. 4-62)

AUTHORITY		P & E SUPVR. (UNIT CODE DATE)	TYPE DESK (UNIT CODE DATE)
W/L ITEM N-116		C.P. 2B 10-22	SWB 213 10-24-62
JOB TITLE			

JOB TITLE  
TED SYS. - REPLACEMENT OF REJECTED FITTINGS

PRODUCTION DEPT.			STRUCT.		OUTFG	ELEC.	MECHANICAL			SERVICE		NUCL. PWR.		PLANNING SUPPLY & COMPTROLLER DEP.								
DISTR.	303C	303D	340	11	17'	38	51	06	31	37	64	71	2302	63	2344B	227	228	229	231	232	233	
33	340A	376	377	23	26	56	67	81	94		72	99	2306	66	245A	239	507	609	565	650	23	251
WORK COMPLETED			DATE			LABOR ( DOLLARS )					OVERHEAD ( DOLLARS )					MATERIAL ( DOLLARS )					TOTAL ( DOLLARS )	
																35.					Juff	

SHEET 1 OF 1

Exh 180-3

## IND-PNS-1714 (REV. 4-62)

[illegible]

SHEET      OF

Exh 180-4

## IND-PNS-1714 (REV. 4-62)

**AUTHORITY.**

W/L ITEM N116

P & E SUPVR. (UNIT CODE DATE )  
CA 2B 11-2

TYPE DESK ( UNIT CODE DATE )  
 213 11/7/62

P.A. 8000 GPD DISTILLERS

14.867

DLI 15346

NOTE - SHOP 66 PROVIDES SHOP  
31 WITH COPY OF DII 15346  
ON SHIPMENT W/955

SHEET / OF /

Exh 180-5

## IND-PNS-1714 (REV. 4-62)

WORK DESCRIPTION							
KEY OP	KEY SHOP WORK CTR.	ASST SHOP WORK CTR.	ESTIMATED MAN HOURS		SCHEDULE	DATES	REF.
			ALLOW	TYPE	START	COMPLETE	
						A. DLI 15408 B. 1862892 PA 8000 GPD STILL	
97	5206		8	A	11-19-62	11-21-62 REPLACE F-5-4 FL-2-3 b(3) FLANGE ON REF. A PER REF A.	

SHEET 1 OF 1  
Exb 180-6

## IND-PNS-87 (REV. 4 - 62)

DATE \_\_\_\_\_

TE 11-16-62

**JOB ORDER**

15-930-90393

PLAN TITLE

P.A 8000 G-PD STILL

PLAN NUMBER &amp; ALT.

DL 15408 FOR 1862892

## PLANNER

CODE

SHIP ACTIVITY

280	SS(N) 593
-----	-----------

GROUP NUMBER

DMR

11-19-62

SHEET 1 OF 1

Exh 180-7

IND-PNS-1714 (REV. 4-62)

### AUTHORITY

P &amp; E SUPVR. (UNIT CODE DATE )

TYPE DESK ( UNIT CODE DATE )

**JOB TITLE**

**b(3) 10 USC 1;**

-(FG ON PL 1862892)

11-28-62

DISTR.	PRODUCTION DEPT.			STRUCT.	OUTFG	ELEC.	MECHANICAL		SERVICE		NUCL. PWR.		PLANNING SUPPLY & COMPTROLLER DEP								
	303C	303D	340	11	17	38	51	06	31	37	64	71	2302	63	2344B	227	228	229	231	232	233
53	340A	376	377	23	26	56	67	81	94		72	99	2306	66	245A	239	507	609	565	650	
WORK COMPLETED				DATE		LABOR ( DOLLARS )				OVERHEAD ( DOLLARS )				MATERIAL ( DOLLARS )				TOTALS ( DOLLARS )			
														255				P			

SHEET / OF /

Exh 180-8

## INJ-PNS-87 (REV. 4 - 62)

DATE \_\_\_\_\_

11-28-62

## JOB ORDER

15-980-90393

**PLAN TITLE**

S.W. STRAINER-"Y" TYPE SIL. BRZ

**b(3) 10 U**

PLAN NUMBER &amp; ALT.

1863434 For CR 56-592-23

## PLANNER

CODE

SHIP ACTIVITY

GROUP NUMBER

DMR

284

THRESHER

8 1862892

V1-28-62

[illegible]

DISTR.	PRODUCTION DEPT.			STRUCT.	OUTFG	ELEC.	MECHANICAL			SERVICE		NUCL. PWR.		PLANNING SUPPLY & COMPTROLLER DEP												
	303C	303D	340	11	17	38	51	06	31	37	64	71	2302	63	2344B	227	228	229	231	232	233					
	340A	376	377	23	26	56	67	81	94		72	99	2306	66	245A	239	507	524	565	650						

**SHEET**

OF

Exh 180-9

## IND-PNS-1714 (REV. 4-62)

b (6)

WORK DESCRIPTION								
KEY OP	KEY SHOP WORK CTR.	ASST SHOP WORK CTR.	ESTIMATED MAN HOURS		SCHEDULE	DATES	REF.	
			ALLOW	TYPE	START	COMPLETE		
						A. DLI #15545 B. 1862606		
13	5606		24	A	12-12-62	12-14-62	INSTALL F-7, F-27 & P-7-3 PER REF ALL MATERIAL IS SS 56  F-7 G 4730-289-8470 F-27 G 4730-542-4364 P-7-3 G 4710-542-1915	A.D.

DISTR  
33

## JOB ORDER

IND-PNS-1714 (REV. 4-62)

IND-PNS-1714 (REV. 4-62)

<b>RAINFALL</b>		<b>CODE</b>	<b>BY ANALYST</b>	<b>CODE</b>	<b>SHIP ACTIVITY</b>	<b>JOB ORDER NUMBER</b>
b(6)		377A	b(6)	ZBD	SS(N) 593	15-930-90393
<b>DATE SCHEDULED</b>	<b>PHONE</b>	<b>DATE PREPARED</b>	<b>PHONE</b>			
11-10-62	1363	10-8-62	206			

AUTHORITY W/L ITEM N-116	P & E SUPVR. (UNIT CODE DATE) CA 2B 10-8	TYPE DESK (UNIT CODE DATE) JMB 213 4/1/82
JOB TITLE		

JOB TITLE  
S.W. SIL-BRZ INTEGRITY INSPECTION 10-10-62

[illegible]

30 DISTR.	PRODUCTION DEPT.		STRUCT.		OUTFG	ELEC.	MECHANICAL			SERVICE		NUCL. PWR.		PLANNING SUPPLY & COMPTROLLER DEP										
	303G	303D	340	11	17	36	51	06	31	37	64	71	2302	63	2344B	227	228	229	231	232	233			
	340A	376	377	23	26	56	67	81	94		72	99	2306	66	245A	239	507	609	565	650				

WORK COMPLETED	DATE	LABOR ( DOLLARS )	OVERHEAD ( DOLLARS )	MATERIAL ( DOLLARS )	TOTAL ( DOLLARS )

IND-PNS-1714 (REV. 4-62)

SHIP ACTIVITY  
SS(N) 593

JOB ORDER NUMBER  
15-938-90293

b (6)

CODE	PLAN
R77D	b (6)

CODE  
280

SHIP ACTIVITY  
SS(N) 593

JOB ORDER NUMBER  
15-938-90293

DATE SCHEDULED	PHONE	DATE PREPARED	PHONE
11-19-62	1363	11-14-62	206

P &amp; E SUPVR. (UNIT CODE DATE )

TYPE DESK ( UNIT CODE DATE )
------------------------------

### AUTHORITY

W/L ITEM N-116

CA 2B 11-14

TYPE DESK ( UNIT CODE DATE )
------------------------------

**JOB TITLE**

VISUAL & ULTRASONIC INSPECTION OF SALT WATER SYSTEM

### WORK DESCRIPTION

SHEET      OF

Exh 180-12

263B

VESSEL		593		SERIAL	NO 15263
FROM CODE 244		SIGNATURE b(6)		233	
TO: SHOP X-56		SIGNATURE		1, R-2, R-7 & R-8	
DATE		HOUR		15-930-90393-5	
10/16		10		(SIGNATURE)	
SUBJECT		1862776-P.A. TRIM & DRAIN SYS-AMIDSHIPS			
THE FOLLOWING WORK IS AUTHORIZED:		FR 47 P			

REMOVE FOLLOWING FTGS & REPLACE

F-9-1 & F-9-2 ON P-38 (3" ELLS)

F-19-1 ON P-33-1 (3" TEE)

F-7-2 ON P-36-1 (4" ELL  
NOTE: DO NOT CUT PIPE

MAT'L REQ

(2) 3"-90° ELLS, SILS (1385766) STR# 44730-289-8472

(1) 4"-90° ELL, SILS (1385766) STR# 44730-289-8474

(1) 3"-TEE, SILS (1385766) STR# 44730-342-4366

TO FACILITATE INSTALLATION REMOVE

VALVES TD-7 & TD-9 FROM FDN.

263B

VESSEL

593

b (6)

SERIAL

No

15264

77W 77Z

FROM: CODE 244

SIGNATUR

TO: SHOP

X56

SIGNATUR

DATE

10/16

HOUR

P&E (SIGNATURE)

15-930-90393-5

SUBJECT

1862780-P.A. TRIM & DRAIN SYS-AMS

THE FOLLOWING WORK IS AUTHORIZED:

REMOVE & REPLACE FLG FL-2-7 ON P-8-2  
(FWD OF TD-4) REMOVE TD-4 TO FACILITATE  
INSTALLATION.

REMOVE & REPLACE COUPLING F-4-1 ON  
P-1-3. UNBOLT FLGS TO TD-77-XF-101 &  
TD-167 TO FACILITATE INSTALLATION.

MATL REQ

(1) 3" COUPLING, SILS (F-4-1) 1385766  
STK # 94730-289-8495

(1) 3" FLG, SILS (FL-2-7) 1385860 GROOVED

2638

VESSEL		593		SERIAL		N <sup>o</sup> 15265	
FROM: CODE 244		SIGNAT		79V		R-11	
TO: SHOP X-56		SIGNAT					
DATE		HOUR		P&E (SIGNATURE)			
10/16				15-930-90393-5			
SUBJECT		1862782-PA. TRIM & DRAIN SYS-ENG RM					
THE FOLLOWING WORK IS AUTHORIZED:							

REMOVE & REPLACE COUPLING F-1  
ON P-50-3 REMOVE BOLTING TO TD 30  
TO FACILITATE INSTALLATION.

MATL REQ  
(1) 3" COUPLING SLS 1385766 (F-1)  
STR # 64730-289-8495

263B

VESSEL		593		SERIAL	No 15274
FROM: CODE 244		SIGNATURE b(6)		79V	
TO: SHOP X56		SI		R-12 & R-13	
DATE	10/22	HOUR	P&E (SIGNATURE)		
SUBJECT		15-930-90393			
1862782- P.A. TED SYS - ENG RM					
THE FOLLOWING WORK IS AUTHORIZED:					

REMOVE & REPLACE ELL F-4-9 ON  
P-54-9. UNBOLT FLGS AT SOUND ISO JOINTS  
TO FACILITATE INSTALLATION.

REMOVE & REPLACE COUPLING F-101-1 ON  
P-54-7. UNBOLT FLGS AT SOUND ISO JOINTS  
TO FACILITATE INSTALLATION

MATL REQ

(1) 4 90° ELL, SILS, BRZ STK# 4730-289-8474

(1) 4" COUPLING, SILS, BRZ STK# 4730-289-8497

263B

VESSEL		593		SERIAL (No) 15335	
FROM: CODE 244		SIGNATURE b(6)		78V	
TO: SHOP X-56		SIGNATURE		R-14	
DATE		HOUR		FREE (SIGNATURE)	
10/24				15-930-90393	
SUBJECT					

1862782 - P.A. TRIM & DRAIN SYS - Eng Rm

THE FOLLOWING WORK IS AUTHORIZED:

P&E PROVIDE MATL

REMOVE & REPLACE F-1-3 ON

P-191-3

MATL REQ

(1) 3" COUPLING, SILS, BAY 123.164.

STK # H4730-289-8495

261B

VESSEL		593		SERIAL	No 15346
FROM: CODE 244	SIGNATURE	b(6)			
TO: SHOP X-56	SIGNATURE	R-16			
DATE	HOUR	P&E (SIGNATURE)			
10/26		15-930-90393			

SUBJECT 1862892-PA. 8000 GPD DISTILLER.

THE FOLLOWING WORK IS AUTHORIZED:

P&E PROVIDE MATL  
X-56 UNBOLT FLGS AT JD-2 & JD-4 & REMOVE  
STRAINER F-6-2 & ASSOC. FTGS.

REMOVE ELLS F-5-3 & F-5-4

X-31 MACHINE P-1-12 & P-1-13 FROM

STRAINER, SOCKETS & SILS GROOVES TO  
BE MACHINED IN ACCORD WITH DWG 1385706  
R-56 REASSEMBLE WITH NEW ELLS & NIPPLES  
TEST & ULTRASONIC EXAM BEFORE REINSTALLING  
IN SHIP

MATL REQ

(2) ELLS 2 1/2" SILS BRZ (F-5-3 & F-5-4) STR# 14730-289-

18" 2.875 x .134 CU IN TUB. (P-1-12 & P-1-13) STR# 8471  
94710-595-

DESIGN LIAISON INSTRUCTION 180-PNS-1016 (REV 10-66)

Exh 180-18

1916

VESSEL		593		SERIAL	(No) 15408
FROM: CODE 244	SIGNATURE	b (6)			
TO: SHOP X-56	SIGN.	R-17 & R-18			
DATE	NOV.	11/5			
SUBJECT	FOR SIGNATURE	15-930-91393			
1862892-P.A. 8000 GPD STILL					
THE FOLLOWING WORK IS AUTHORIZED:					

REMOVE & REPLACE 2 1/2" ELL (F-5-4)  
ON P-1-14 & 2 1/2" FLG (FL-2-3) ON P-1-26

MATL REQ

- (1) 2 1/2" ELL, SILS, BR, DWG 1385766 (F-5-4)  
STK # H4730-289-8471
- (1) 2 1/2" FLG, SILS, BR, DWG 1385860 (PAIN)  
(FL-2-3)

RE:- FG5 DO NOT MEET MIN REQUIREMENTS  
FOR BOND (ULTRASONIC EXAM)  
DESIGN LIAISON INSTRUCTION 180-PHS-1818 (Rev 10-66)

Exh 180-19

263B

VESSEL

593

SERIAL

NO

15545

FROM: CODE 244

R-21

TO: SHOP

56

DATE

12042

HOUR

P&E (SIGNATURE)

15-930-90393

SUBJECT

AUX S.W. A.R.M. FR 50 S

1862606

THE FOLLOWING WORK IS AUTHORIZED:

DLI 15375

P & E PROVIDE

ELBOW F-7

TEE F-27

PIPE P-7-3

REA: ALIGNMENT DIFFICULTIES  
IN PERFORMING WORK ON DLI 15375

CONDITION REPORT (SPECS.) File No.  
IND-PNS-1018 (New 2-56)

REPORT PNS-4850-28

SERIAL NO. SS(N)593/2663T

SHEET NO. 1 OF 1

SHIP SS(N)593 THRESHER		JOB ORDER 15-930-90393		EQUIPMENT S.W. Sil-Braze Integrity Inspection	
CLASS OF SHIP					
OPENING DATE		CLOSING DATE		SERIAL	
				UNIT NO.	
WITNESSED BY				CLASSIFICATION	
MECHANIC		ANALYST		DATA FROM (See References)	
CHECKED BY LGHM.		DATE		PREPARED BY	
				R. C. ARNOLD	
CHECKED BY QTMN.		DATE		DATE	
E. FITE		11-8-62		R. E. FITE	
				11-8-62	

REFERENCES  
(a) 1862606 (b) BUSHIPS ltr C SS(N)593 C1/9320 ser 525-0232 of 28 Aug 1962

An ultrasonic examination was conducted on the silver brazed joints for the fwd ASW system, in accordance with reference (b):

**b(3)** Tee (F27-1) on Line P6-1 at Fr 50 stbd side Air Regen. room, on reference (a), fitting did not meet the minimum bond requirements according to reference (b).

Copy to:  
232B  
227  
313  
CO SS(N)593  
X56  
303B-2

*Answered 11-14-62  
Referred to Design  
for Action*

COPIES TO:  
☐ CODE 230 (3) ☐ CODE 330 ☐ C.O. VESSEL ☐ SHOP FILE

Navy-DPPO IND, Portsmouth, N.H.

*Exh 180-21*

REPORT PNS-4850-28

An ultrasonic examination was conducted on the Sil-Brz joints for the Trim and Drain piping, to Nos. 1 and 2 auxiliary tanks, in accordance with reference (b).

- (1) Four inch elbow (F-7-2) on line P36-1 on reference (a) did not meet the minimum bond requirements according to reference (b).
- (2) Three inch elbow (F-9-2) on line P38-2 reference (a) did not meet the minimum bond requirements, according to reference (b)

Copy to:  
261B  
232B  
313  
CO SS(N)593  
X56  
303B-2

Exh 180-22

SOUND VISION REPORT (SPECS.) File No  
100-100-1010 (Rev 2-58)

REPORT PMS-4050-20

GB 14 January 1963

SERIAL NO. 56-593-33

SHEET NO. 1 OF 1

SHIP SS(N)593 THRESHER		JOB ORDER 15-930-51315		EQUIPMENT Hose - Snorkel Head Valve	
CLASS OF SHIP					
OPENING DATE		CLOSING DATE		MATERIAL	
BY THE ORDER OF				CLASSIFICATION	
MECHANIC L. Rizzo		ANALYST		DATA FROM (See Remarks)	
CHECKED BY LOGS H. Jutras		DATE 1-11-63		PREPARED BY	
CHECKED BY OTHER C. Collins		DATE 1-11-63		APPROVED BY	
SUPERVISOR				DATE	
Plan 1863326					

Swivel nut Pc. 30 is cracked on hose assy Pc. 32. We tried to install new Pc. 30 on hose but cannot insert man drill into the hose on boat. The inside diameter is too small. We will need new hose Pc. 32 - 30 feet long. 30' - Pc. 32 equal to Eastman H5008.

b(6)

*memo  
1/21*

232 BC

COPIES TO CODE 207(3)	CODE 330	C.O. VESSEL	SHIP FILE	Qtrm. Collins
--------------------------	----------	-------------	-----------	---------------

Exh 180-23

BJG

PORTSMOUTH NAVAL SHIPYARD  
PORTSMOUTH, N. H.

213  
SS(N)593/9480

WUG -9 1302

From: Commander, Portsmouth Naval Shipyard  
To: Chief, Bureau of Ships

Subj: Piping Joint Inspection, Sea Water Systems,  
USS THRESHER (SS(N)593)

Ref: (a) BUSHIPS ltr Ser 525-1325 of 29 May 1962  
(b) BUSHIPS ltr Ser 648X-160 of 13 Feb 1962  
(c) PSA Arrival Conference for USS THRESHER (SS(N)593)

1. Paragraph 3 of reference (a) indicated that the visual inspection of subparagraph 1.a. and the certification of subparagraph 1.d. of reference (b) would be required for sea water systems of USS THRESHER (SS(N)593) post shakedown availability. As discussed in reference (c), this inspection is considered neither feasible nor necessary for any reasonable length of availability assigned to THRESHER. The amount of interference to be removed precludes the accomplishment of a complete visual inspection of THRESHER sea water systems.

2. As agreed by all attendees at reference (c) the following inspection of sea water systems will be accomplished during THRESHER PSA.

a. Visual inspection of all sil-brazed joints two inches and above, which are unlagged and readily accessible, including all joints between hull and backup valves. Ultrasonic test all suspect joints found by this visual inspection.

*As defined by NAVSHIPS 250-695-8*

b. Complete inspection of all sil-brazed joint repairs made by Ship's Force in any system as a result of shock damage, and repair as necessary.

c...Hydrostatic (drop) test of all sea water systems to 1-1/2 times submergence pressure and repair of joints as necessary.

d. Complete inspection of joints in sea water systems where extensive damage to pipe hangers indicates the possibility of weakened joints.

Ref: (js)

Ex 181-1

BJG

213  
SS(N)593/9480

3. Paragraph 4 of reference (a) indicated that a course of action would be transmitted to this Shipyard regarding six hydraulic joints in THRESHER containing irregularities. This information has not been received to date. Immediate action is requested.

b (6)

  
HARRY A. JACKSON  
By direction

Copy to:  
BUSHIPS (525)  
COMSUBLANT  
DEPCOMSUBLANT  
COMSUBDEVGRU TWO  
CO, USS THRESHER (SS(N)593)

BJG

Copy to:

210s

213 ✓

227Ak

232B

240

241D

246

263

300

310

303

2301

2306

213x  
593

213  
SS(N) 593/9480

Ex 181-3

**ORIGINAL**  
COMMANDER SUBMARINE FORCE  
UNITED STATES ATLANTIC FLEET

FF4-12  
9480/SSN593  
Ser: DEP 402/N 6544  
7 Sep 1962

From: Commander Submarine Force, U.S. Atlantic Fleet  
To: Commander, Portsmouth Naval Shipyard

Subj: Piping Joint Inspection, Sea Water System, USS THRESHER (SSN593)

Ref: (a) COMNAVSHIPYD PTSMH ltr ser 213 SSN593/9480 of 9 AUG 1962  
(b) Fonecon my LCDR KRAG your LCDR BILLINGS 31 AUG  
(c) COMSUBLANT ltr ser DEP 406/N5855 of 10 AUG 1962

1. Reference (a) summarized action planned in connection with inspection of sea water systems in THRESHER during that ship's post shakedown availability (PSA). The work to be accomplished, outlined in reference (a), was agreed upon by attendees at the THRESHER PSA Arrival Conference.

2. Confirming reference (b), it is requested that paragraph 2.a. of reference (a) be modified to read as follows (underlined portions indicate additions):

a. Visual inspection of all sil-brazed joints two inches and above, which are unlagged and readily accessible, including all joints between hull and back up valves. Ultrasonic test all silbrazed joints between and including hull valve and back up valve which can be done without major removals of machinery, piping, foundations or hull structure and all suspect joints, as defined by NAVSHIPS 250-648-8, found by this visual inspection.

3. COMSUBLANT considers that the program outlined by reference (a) as modified above, together with the extensive testing completed earlier in THRESHER, satisfies the intent of reference (c).

b (6)

Copy to:  
COMSUBLANT NORVA  
COMSUBDEVGRU TWO  
CO USS THRESHER (SSN593)  
BUSHIPS (Code 525)

C. J. ZURCHER  
By direction  
Deputy

**ORIGINAL**  
Exhibit 182

EMD

PORTSMOUTH NAVAL SHIPYARD  
PORTSMOUTH, NEW HAMPSHIRE

PTSMH NAVSHIPYD  
INST 5420.25B (100)

PTSMH NAVSHIPYD INSTRUCTION 5420.25B

12 Feb 1963

From: Commander, Portsmouth Naval Shipyard  
To: Distribution List

Subj: Quality Assurance Committee and Coordinator for Quality Assurance

Ref: (a) PTSMH NAVSHIPYD INST 5420.20B  
(b) PTSMH NAVSHIPYD INST 5420.26  
(c) BUSHIPS INST 4355.23  
(d) PTSMH NAVSHIPYD INST P5450.1A

Encl: (1) Membership of Quality Assurance Committee

1. Purpose. To establish a Quality Assurance Committee and a Quality Assurance Coordinator within the procedural framework of references (a) and (b) and to state their responsibilities.

2. Cancels PTSMH NAVSHIPYD INST 5420.25A.

3. Responsibilities.

a. The Quality Assurance Committee established by this Instruction, with membership as specified in enclosure (1), shall, under direction of the Coordinator for Quality Assurance:

(1) Develop and recommend plans, policies, and interdepartmental procedures for the implementation of Quality Assurance Program in accordance with reference (c) and related directives. Ensure that such plans and procedures are integrated with those being developed by other Shipyard committees as appropriate.

(2) Evaluate the implementation, progress, and effectiveness of the Quality Assurance Program and submit progress reports and recommendations to the Management Policy Board per reference (a).

(3) Perform assignments as initiated by the Management Policy Board and as directed by the Shipyard Commander.

(4) Report to the Shipyard Commander on interdepartmental matters via the Management Policy Board.

(5) Serve as Quality Assurance Evaluation Team as required by reference (c) and shall:

EXHIBIT # 183

PTSMH NAVSHIPYD  
INST 5420.25B  
12 Feb 1963

(a) Determine the capability of the Shipyard to perform in accordance with requirements and to verify that there is compliance to requirements.

(b) Provide feedback information on specification deficiencies, training needs, communication problems, manpower needs, deficiencies in systematic planning and other causes of nonconformance to specifications.

b. The Chairman of the Quality Assurance Committee is designated as Coordinator for Quality Assurance Program and shall:

(1) Initiate development, monitor implementation, review and coordinate.

(2) Assign tasks to Committee members and designate task groups from the Committee or other Shipyard personnel with the concurrence of the department or office head concerned.

(3) Report to department heads for matters under their cognizance per reference (d) and related directives.

#### 4. Instructions.

a. The Chairman or, in his absence, the Vice-Chairman shall call meetings as required. The Recorder shall attend all meetings. Those other members of the Committee will be called to attend when their department or office becomes involved in the agenda to be discussed. Departments not represented on the Committee shall be requested to send a representative when matters involving their departments are under consideration. Members may be represented by alternates only when absent from the Shipyard on leave or on temporary additional duty and may have supporting technical personnel as appropriate.

b. Plans, procedures and recommendations shall be submitted in accordance with reference (b) to the Management Policy Board for approval prior to the submission to the Shipyard Commander.

c. An approved Quality Assurance Program Plan of Action and approved pertinent recommendations are official Shipyard directives and documents. The tasks assigned therein must be implemented by the responsible action and assist codes within the established "target" or completion dates. Department and office heads and the immediate supervisors of the assigned action and assist codes for each of the various tasks must make arrangements to enable these codes to accomplish the tasks within the time prescribed. Under normal conditions, the assigned Quality Assurance

PTSMH NAVSHIPYD  
INST 5420.25B  
12 Feb 1963

tasks shall have precedence over the regular duties of these personnel. Whenever such a precedence is not feasible, the department or office head must notify the Chairman of the Committee promptly and offer a suitable alternate proposal so as not to jeopardize the timely implementation of the approved plan of action or recommendations.

5. Shipyard Code Number Assignment. The Chairman of the Quality Assurance Committee is assigned Shipyard Code Number 104D.

C. J. PALMER

DISTRIBUTION:

B, G-1, G-2;  
C (200, 300, 500, 600);  
141D, 2305, 303, 946,  
560, 2343, 250

AUTHENTICATED:

b (6)

Secretary to the Commander

Enclosure (1)

PTSMH NAVSHIPYD  
INST 5420.25B  
12 Feb 1963

MEMBERSHIP OF QUALITY ASSURANCE COMMITTEE

Chairman: Quality Assurance Superintendent (303)

Vice-Chairman: Assistant Chief Design Engineer for Naval  
Architecture (250)

Recorder: Management Analyst (141D)

Members: Head Combat Systems Division Engineer (2343)  
Material Superintendent (560)  
Head, Reactor Plant Quality Assurance Engineering  
and Analysis Branch (2305)  
Group Master, Mechanical (946)

Enclosure (1)

PORTSMOUTH NAVAL SHIPYARD  
PORTSMOUTH, NEW HAMPSHIRE

PTSMH NAVSHIPYD  
INST 5420.25A (100)

PTSMH NAVSHIPYD INSTRUCTION 5420.25A

20 Nov 1962

From: Commander, Portsmouth Naval Shipyard  
To: Distribution List

Subj: Quality Assurance Committee

Ref: (a) PTSMH NAVSHIPYD INST 5420.20A

Encl: (1) Membership of Quality Assurance Committee

1. Purpose. To establish a Quality Assurance Committee within the procedural framework of reference (a).

2. Cancels PTSMH NAVSHIPYD INST 5420.25.

3. Responsibility. The Quality Assurance Committee, established by this Instruction, with membership as specified in enclosure (1), will:

a. Assist and advise the Shipyard Commander, the Management Policy Board, department and office heads, and the \*Quality Assurance Superintendent\* in developing and maintaining a Quality Assurance Program necessary to minimize the quality problems encountered in delivering satisfactory equipment and ships to the Fleet.

b. Keep the Management Policy Board and other committees informed, as appropriate, where areas of interest develop.

c. Review and evaluate the implementation, progress, and effectiveness of the Shipyard-established Quality Assurance programs and submit recommendations covering interdepartmental matters to the Shipyard Management Policy Board, per reference (a).

d. Perform Quality Assurance assignments as initiated by the Shipyard Management Policy Board and as directed by the Shipyard Commander.

4. Instructions.

\*a. The chairman or, in his absence, the vice chairman shall call meetings as required. Members and the recorder shall attend all meetings unless specifically excused by the chairman. Each shall make arrangements for an alternate to attend when the principal is not available. Other parties having an interest in the agenda of the day may be invited by the chairman to attend.\*

EXH 184-1

PTSMH NAVSHIPYD  
INST 5420.25A  
20 Nov 1962

b. Plans, programs, procedures, and recommendations of an inter-departmental nature will be submitted to the Management Policy Board for approval prior to the submission of proposed implementing directives to the Shipyard Commander.

5. Code Number Assignment. The Chairman of the Quality Assurance Committee is assigned Shipyard Code Number 104D.

b (6)

G. J. PALMER

DISTRIBUTION:

B, G-1, G-2, N;  
C (200, 300, 400, 500);  
141D  
303A, 316, 303A1, 2305,  
2346, 2344A-B, 231,  
303B, 303C, 303D, 374,  
242A, 243M, 926

Enclosure (1)

PTSMH NAVSHIPYD  
INST 5420.25A  
20 Nov 1962

MEMBERSHIP OF QUALITY ASSURANCE COMMITTEE

*Chairman	Quality Assurance Superintendent (303)
Vice Chairman:	Assistant Chief Design Engineer for Naval Architecture (250)
Recorder:	Management Analyst (141D)
Members:	Head Combat Systems Division Engineer (2343)
	Material Superintendent (560)
	Head, Reactor Plant Quality Assurance Engineering and Analysis Branch (2305)
	Group Master, Mechanical (946)*

Enclosure (1)

EXH 184-3

~~SECRET~~  
7 Dec. 1962

EXH 185-1

# QUALITY ASSURANCE PROGRAM

## PORTSMOUTH NAVAL SHIPYARD

### PLAN OF ACTION

b (6)

**DISTRIBUTION:**

B, C, G-1,  
Members of QA Committee  
104, 104B, 104C, 104A  
Each assist code

APPROVED BY \_\_\_\_\_

ACCEPTED BY \_\_\_\_\_

SUBMITTED BY \_\_\_\_\_

EXH 185

PORTSMOUTH NAVAL SHIPYARD QUALITY ASSURANCE PROGRAM

PLAN OF ACTION

PREFACE

EXH 185-2

1. The tasks outlined in this Plan of Action are those presently considered to be most essential to the timely fulfillment of the requirements of BUSHIPS Instructions and for the establishment of an efficient Quality Assurance system. The frequency of revision of this Plan will be governed by the new tasks assigned and by the number of tasks which have undergone a significant change in status since the previous revision.
2. For each item in this Plan of Action, the Task Group shall be composed of the Action Code shown opposite that item and the Assist Codes.
  - a. The Action Code shall bear full responsibility for the satisfactory completion of the assigned tasks and for submission of results to the Quality Assurance Committee by the date shown. He shall serve as Chairman of the Task Group.
  - b. Assist Codes shall provide whatever assistance is called for by the Action Code, placing the accomplishment of such assignment at a higher priority than his regular work.
  - c. A Task Group shall convene at the direction of its Chairman.
  - d. Completed tasks shall be processed through individual departments and presented to the Quality Assurance Committee in a form suitable for review and examination for conformance to system prior to submission to the Management Policy Board. Copies of correspondence and reports pertaining to an item on the Plan of Action shall be provided to the Recorder (Code 141D).
3. The Recorder shall monitor on a continuing basis the schedule adherence by the action codes and shall follow up on progress until completion of the task. He will advise the chairman and members on status of the plan at each regular meeting or whenever a task appears to need follow-up or monitoring action by the Committee.
4. A Task Group shall, upon direction of 104D, monitor the implementation of recommendations made by the Committee and approved by the Management Policy Board, in order to verify compliance with directives.

EXH 185-3

5. Shipyard Directives pertinent to the Quality Assurance program are:

PTSMH SHIPYD INSTR	4030.1	Unpacking instructions
	4122.1	Screw Thread Standards
	4355.1	Correction of defects
	4410.1	TARGET Material
	4730.2	Testing new equipment
	4730.3	Testing reactor plant
	4730.4A	Production test programs
	4730.5	NDT of Castings
	4730.6	Inspection of Combat Systems
	4730.7	Combat Systems contractor representatives
	4760.1	Mercury contamination
	4855.1	ARROW material
	4855.2	Quality Assurance responsibilities
	9080.1C	Preliminary Acceptance Trials
	9080.2A	Shipboard test responsibilities
	9080.3A	Sea Trial deficiencies
	9110.3	Hull surveys
	9110.4	HY-80 fabrication and inspection
	9400.2B	Acoustical surveys
	9480.1	Noise reduction
	9650.1	Luminous markers
	9670.3	Ships' electronic systems
	9690.1A	Electronic test equipment
PTSMH SHIPYD NOTICE	9480 (14 Sep 62)	NDT requirements

TASK NO. (Old No.)	SUBJECT	DIREC- TIVE NO.	ACTN CODE	ASST CODES	DATE TO BE SUB- MITTED TO QA COMM.	DATE TO GO TO MGMT POL. BOARD	ACTUAL DATE TO MG. POL. BOARD	REMARKS
1. (11)	Purchase Documents		560	530 303A	12 Dec	31 Dec		Develop procedures to ensure incorporation into all procurement documents of required specifications & inspection requirements.
✓ 2. (7)	Nondestructive Test of Castings	PORTS 4730.5	250	303E 981 260	19 Dec	31 Dec		Revise Shipyd directives & procedures to comply with new requirements and Change Orders 191.1 and 284.
✓ 3. (2)	Policy and Objectives	BUSHIPS 4355.14	303	2305 2342	19 Dec	7 Jan 1963		Define and promulgate Shipyd policy & objectives with regard to QA Control
✓ 4. (19)	Problem Investigation		2305	303A	19 Dec	2 Jan 1963		Develop procedures for investigating QA/QC problems to ascertain scope, magnitude, cause & cost.
✓ 5. (23)	Shipyard Instructions	BUSHIPS 4355.14	141D	303A 380 504	2 Jan 1963	14 Jan 1963		Review all Shipyd Instruc. with QA in mind. Recommend changes or revision to clarify responsibility, eliminate conflict or redundancy, assure quality.
✓ 6. (24)	Process Instructions	BUSHIPS 4355.14	303	380 949 226 504 243M	2 Jan 1963	14 Jan 1963		Review all Process Instructions. Recommend changes or revision to improve methods, rectify responsibility, eliminate conflict or redundancy, & incorporate best QA doctrine.
✓ 7. (4)	Indicating System		303	380 956	2 Jan 1963	14 Jan 1963		Develop a single coordinated system of labeling & tagging to show what test passed by whom. Combine existing Instructions into one.

EXH 185-4

TASK NO. (Old No.)	SUBJECT	DIREC- TIVE NO.	ACTN CODE	ASST CODES	DATE TO BE SUB- MITTED TO QA COMM.	DATE TO GO TO MGMT POL BOARD	ACTUAL DATE TO MGMT POL BOARD	REMARKS
✓ 8. (10)	Pipe Joint Control	PTSMH 4855.1 4410.1	303	2343 263 303A	9 Jan 1963	21 Jan 1963		Revise procedures for control of piping joints & system components throughout procurement, installation & testing.
✓ 9. (8)	Drawings & Specifica- tions		250	244E	16 Jan 1963	28 Jan 1963		Prepare Design Div Inst to provide for adequate technical review of specifications, drawings & material requests.
✓ 10. (9)	Incorporation of Changes		303	303A 244	23 Jan 1963	4 Feb 1963		Establish control of incorporation of <u>changes</u> in requirements for test standards, specifications & procurement documents.
✓ 11.	Follow Ship Procurement		250	226 931	30 Jan 1963	11 Feb 1963		Prepare a P&E Instr Sheet to provide for adequate technical & QA review of lead yard procurement documents.
✓ 12. (25)	Technical Assistance		303	2343 246	6 Feb 1963	18 Feb 1963		Study effect on efficiency of providing increased technical assistance to shops & QA organization. Recommend action to be taken. (See 100 comment to 310's rep.)
✓ 13. (12, 18)	Feedback of Information	BUSHIPS 4355.20 PTSMH 4355.1	250	<del>212</del> 946 <del>233 A</del> 244	13 Feb 1963	4 Mar 1963		Develop procedures & prepare Instructions whereby deficiencies are immediately reported back to vendor or responsible activity or to the processing shop and designer
✓ 14. (15 16)	Indoctrina- tion & Training	100's 27 Mar 1962	303	180	20 Feb 1963	4 Mar 1963		Develop a QA/QC training program, familiarization campaign & publicity plan.

EXH 185-5

TASK NO. (Old No.)	SUBJECT	DIREC-TIVE NO.	ACTN CODE	ASST CODES	DATE TO BE SUB-MITTED TO QA COMM.	DATE TO GO TO MGMT POL BOARD	ACTUAL DATE TO MGMT POL BOARD	REMARKS
15. (21)	Conformance & Effectiveness		303		27 Feb 1963	11 Mar 1963		Prepare a plan for audit & evaluation of general conformance to establish QA directives & procedures, & of effectiveness & cost of application of these procedures.
16. (5, 22)	Inspection Procedures	BUSHIPS 4355.20 3.d	303	946 303A 242B 573	Continuing			Develop inspection procedures to include processing of data, in all areas other than Combat Systems & Reactor Plant areas, considering levels of essentiality.
17. (14)	Mechanical Instrument Calibration	BUSHIPS 4355	303	303A 303D 380	20 Feb 1963	4 Mar 1963		Prepare a Shipyard Instruction to require calibration and inspection of instruments, test equipment, jigs and fixtures on a periodic basis. Provide for condemnation & records.

EXH 185-6



DEPARTMENT OF THE NAVY  
BUREAU OF SHIPS  
WASHINGTON 25, D. C.

IN REPLY REFER TO

BUSHIPS 4355.23  
Ser 706-84  
3 December 1962

BUSHIPS INSTRUCTION 4355.23

From: Chief, Bureau of Ships  
To: Commander, All U.S. Naval Shipyards

Subj: Quality Assurance Evaluation Teams; establishment of

Ref: (a) BUSHIPSNOTE 4355 Ser 744-71 of 29 Jun 1962

Encl: (1) Areas for Evaluation

1. Purpose. To establish the Quality Assurance evaluation team concept and assign responsibilities.
2. Background. Quality Assurance responsibilities assigned to the naval shipyards require the performance of Quality Assurance evaluations. Quality Assurance evaluations are performed to determine the capability of an activity to perform in accordance with requirements and to verify that there is compliance to requirements. Quality Assurance evaluations provide feedback information on specification deficiencies, training needs, communication problems, manpower needs, deficiencies in systematic planning and other causes of nonconformance to specifications. Recent Bureau evaluations and results of internal evaluations have indicated the need for improving the development of the capability for performing these evaluations and for actively pursuing the administering of such evaluations.
3. Concept. Quality Assurance evaluation teams shall be established for the purpose of determining compliance with requirements and for providing feedback information on areas of nonconformance to requirements.
4. Action. Each shipyard shall be responsible for the following:
  - a. Establishing teams to perform Quality Assurance evaluations within the shipyard. Each team shall be comprised of personnel from different departments or divisions of the activity depending on the technical knowledge required for a specific evaluation. The team captain shall be from the Quality Assurance Division of the shipyard.
  - b. Developing the capability of the teams for performing Quality Assurance evaluations.

79027

S3231

Exhibit 186-1

BUSHIPSINST 4355.23  
3 December 1962

c. Performing Quality Assurance evaluations within the shipyard of locally identified problem areas and as directed by the Bureau. Enclosure (1) provides examples of some areas for evaluation.

d. Providing personnel upon request for assignment to a Bureau of Ships evaluation team.

5. Training. The Quality Assurance course established by reference (a) provided training in performing evaluations.

b (6)

Copy to:

L3 SUPSHIP  
L40 NAVREPFAC

D. L. Carroll, Jr.  
Assistant Chief of Bureau  
for Field Activities

THIS DIRECTIVE STOCKED AT:  
Supply Dept., NAVSTA (Wash.  
NAVYD Annex, Code 514.25),  
Washington 25, D. C.

Enclosure (1)

BUSHIPSINST 4355.23  
3 December 1962

AREAS FOR EVALUATION

- a. Material Identification Control
- b. Metal Joining Processes
- c. Weight Control
- d. Non-Destructive Testing
- e. Shock and Vibration Mounting
- f. Drawing and Document Control
- g. Process Instruction Adequacy
- h. Submarine Antenna Installation

Enclosure (1) to BUSHIPS Ser 706-84

*Exhibit 186-3*

COPIES: 17/5 325 3 608  
DESC  
PAGE 1

File: 279/A/27/EJB

Subject: Ultrasonic Testing of Sil-Brazed Joints, 2" and less in Diameter, located on the Hydraulic Systems of the U.S. S. Thresher SS(N)593; Results of:

Reference: (a) Shop Order 3930-136

Enclosures: 1. Sil-Brazed Ident. Record (E.B. Form 2268) for each joint, total 115.  
2. Road maps indicating location of subject joints, total 12.  
3. Sil-Brace Ident. Record (E.B. Form 2268) indicating results of ultrasonic test of remade joints, total 9.

Supervisor of Shipbuilding, USN  
Groton, Connecticut

S i r :

1. A total of 115 joints in the hydraulic systems, of subject vessel, were ultrasonically tested in accordance with reference (a).
2. The following is a joint breakdown by systems, as indicated on enclosure 2.

<u>System</u>	<u>Road Map</u>	<u>No. of Joints</u>
Steering and Stern Dive	1	25
Steering and Stern Dive	2	20
Main and Vital	3	13
Lead Accumulator	4	11
Vital Accumulator	5	18
Main and Vital	6	4
Steering and Stern Dive	7	10
Hydraulic Power Plant	8	2
Steering and Stern Dive	9	5
Main and Vital Hydraulic	10	4
Main and Vital Hydraulic	11	2
Steering and Stern Dive	12	1
TOTAL JOINTS-----		115

3. All joints were ultrasonically attempted and results were informative in all, except for joints 74, 77 and 78, on road map 5, which were inaccessible for ultrasonic test on the inner land.
4. Joint number 16, on road map number 1, and joint number 49, on road map number 3, were rejected due to unsatisfactory bond.  
(a) Joint number 16 was removed from the ship, sectioned, peeled and visual examination verified the unsatisfactory bonding as deter-

EXH 187-1

mined by ultrasonic test. Visual examination further revealed that the pipe was not bottomed in the reducing bushing and that a 5/16" filler piece was inserted between the bottom of the pipe and bushing. A new 2" x 1 1/2" reducing coupling was cast, eliminating joint number 17 and the reducing bushing. This joint was sil-brazed in the ship and satisfactory bonding attained as indicated on enclosure 3 for that joint.

(b) Joint number 49 was removed from the ship, sectioned, peeled and visual examination verified the unsatisfactory bonding as determined by ultrasonic test. Visual examination further revealed that no insert ring was installed and that the joint was face-fed. A replacement fitting was used, the joint was sil-brazed in the shop, and satisfactory bonding attained as indicated on enclosure 3 for that joint.

5. Joint numbers 11, 12, 13 and 18, on roadmap number 1, and 18, 50 and 51, on road map 3, were remade, and replacement fittings used, as a result of removing joints 16 and 49. The final bonding attained to these joints, before installation in the ship, is as indicated on enclosure 3, for the applicable joint.
6. Joint numbers 30, 40, 46, 56, 69 and 73, although below the minimum standard of 25 per cent for one land, are considered satisfactory by Electric Boat Division and Navy Inspection, due to total bond in excess of 40 per cent and the high percentage of bond to the outer land.
7. Results of these various inspectionw were reviewed by Electric Boat Division and Navy Inspection. For each joint ultrasonically tested, on board ship, the information was assembled and the joint considered and rated as shown on enclosure 1, for the applicable joint.

b (6)

J. Behney  
Manager of Quality Control

EM/hop

cc: (b) (6)

SmShina

(4)

EXH 187-2

SS(N)593

Silver brazed piping joints 2" IPS and over subject to submergence pressure in Trim & Drain, Auxiliary Sea Water and 8000 GPD distiller systems which were ultrasonically tested during post-shakedown availability.

EXH 188-1

SS(N)593

Silver brazed piping joints which were made in sea water submergence pressure systems during the post-shakedown availability, showing results of ultrasonic inspections.

<u>Plan</u>	<u>Joint Number</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage.....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
<u>FWD ROOM - TRIM AND DRAIN SYSTEM</u>						
1862775	* ELL F-2-B - P-13(A)	4	0	61	5	33
"	* F-2-B - P-13(B)	"	0	58	35	46.5
"	* Tee F-1-C - P-13(A)	4	0	65	0	32.5
"	Flange FL-2-2 - P-18-1	3	0	70	71	<u>70</u>
"	Flange FL-2-3 - P-18-3	"	0	90	91	<u>90</u>
"	ELL F-9-1 - P-18-1	"	0	83	85	<u>84</u>
"	ELL F-9-1 - P-18-2	"	0	84	84	<u>84</u>
"	Flange FL-2-5 - P-18-4	"	0	90	92	<u>91</u>
"	Tee F-8-1 - P-18-4	"	0	74	80	<u>86</u>
"	F-8-1 - P-18-3	"	0	70	68	<u>69</u>
"	F-8-1 - P-18-2	"	0	87	79	<u>83</u>
"	<del>ELL P13 F2B(B)</del>	<del>4</del>	<del>0</del>	<del>58</del>	<del>35</del>	<del>46.5</del>

AMIDSHIPS COMPT - A.S.W. SYSTEM

1862606	Coup P-10-2B/ANF-92-1	b(3) 10 USC 120	0	59	23	41
"	" ANF "		1	63	23	43
"	P-10-2B/1ANF-92-1		2	62	44	<u>53</u>
"	Coup P-10-2A/ANF-92-1		0	73	71	72
"	P-10-2A/1ANF-92-1		1	14	3	8
"	P-10-2A/2ANF-92-1		2	60	50	<u>55</u>

\* Replaced by welded fittings (x) (y) (z) respectively

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections

<u>Plan</u>	<u>Joint Number</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
<u>AMIDSHIPS COMPT - A.S.W. SYSTEM (continued)</u>						
1862606	Flgell P-8-2/F-22-1	b(3) 10 USC 130	0	72	57	64.5
"	Flgell P-8-2/NF-22-1		1	55	65	<u>60</u>
"	Flange P-7-3/FL-5-3		0	71	60	<u>65</u>
"	ELL P-7-4/F-7-1		0	62	48	55
"	ELL P-7-4/NF7-1		1	41	50	<u>45.5</u>
"	ELL P-7-5/F7-1		0	57	43	50
"	ELL P-7-5/NF7-1		1	65	66	<u>65.5</u>
"	Tee P7-3/NF27-1		0	37	33	35
"	Tee P7-3/1NF27-1		1	28	43	35.5
"	Tee P7-3/3NF-27-1		2	55	52	<u>53.5</u>
"	Tee P8-1/F27-1		0	55	68	<u>61</u>
"	Tee P7-5/F27-1		0	51	52	51.5
"	Tee P8-1/NF27-1		1	67	56	61.5
"	Tee P8-1/2NF-27-1		2	71	56	63.5
"	Tee P8-1/3NF-27-1		3	61	65	<u>63</u>
"	Tee P6-1/F-27-1		0	68	20	44
"	Tee P6-1/NF27-1		1	67	62	64.5
"	Tee P6-1/2NF-27-1		2	45	32	38.5
"	" "		3	46	35	40.5
"	Tee P6-1/3NF-27-1		4	50	60	<u>55</u>
"	ELL P7-1/NF-7-1		0	61	68	<u>64.5</u>
"	ELL P7-2/NF-7-1		0	66	56	<u>61</u>
"	FLG P1-1/FL-12-1		0	70	65	67.5

**SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections**

<u>Plan</u>	<u>Joint Number</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage.....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
<b>AMIDSHIPS COMPT - A.S.W. SYSTEM (continued)</b>						
1862606	Flange F-40-4/FL5-9	b(3) 10 USC 130	0	75	*	--
"	Flange P8-4/FL5-8		0	80	*	--
"	Tee P6-1/F-9-1		0	55	67	<u>61</u>
"	Tee P-6-2/F-9-1		0	48	57	<u>52.5</u>
"	Flange P-6-2/FL-5-1		0	51	*	--
"	ELL P-4-1/F-7		0	58	70	<u>64</u>
"	Flange P-4-1/FL-5		0	78	*	--
"	ELL P-4/F-7		0	59	76	<u>67.5</u>
"	ELL P-4/F-2 (48S)		0	80	74	<u>77</u>
"	ELL P-4/F-2 (50S)		0	80	58	<u>69</u>
"	Flange P-4/FL-5		0	61	*	--
"	Coup P-6-1A/ANF-92-2		0	62	67	<u>64.5</u>
"	Coup P-6-1B/ANF-92-2		0	78	72	<u>75</u>
"	FL ELL P-7-3/NF-23-1		0	73	69	<u>71</u>
"	FL ELL P-7-2B/NF-23-2		0	6	14	10 18
"	P-7-2B/1NF-23-2		1	25	65	<u>45</u>
"	Tee P-10-2/NF-8-1		0	50	41	<u>45.5</u>
"	P-10-1/NF-8-1		0	31	57	<u>44</u>

**AMIDSHIPS COMPT - TRIM AND DRAIN SYSTEM**

1862776 #3	Tee P33-2/F19-1	3	0	72	75	<u>73.5</u>
"	Tee P33-1/F19-1	3	0	39	25	32 19
"	Tee P33-1/NF19-1	"	1	15	16	15.5
"	Tee P33-1/1NF19-1	"	2	32	50	41
"	Tee P-33-1/1NF19-1	"	3	59	37	<u>48</u>

\* Inaccessible due to geometry of fitting.

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections

<u>Plan</u>	<u>Joint Number</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage .....</u>		<u>Ave.</u>
				<u>Outer</u>	<u>Inner</u>	
1862776 #3	ELL P-38-1/F9-1	3	0	65	11	38 <sup>26</sup>
"	ELL P-38-1A/NF9-1	3	1	69	45	57
"	ELL P-38-1/1NF9-1	"	2	59	29	44
"	ELL P38-1/2NF9-1	"	3	58	42	<u>50</u>
"	ELL P33-3/NF9-1	"	0	77	71	<u>74</u>
"	ELL P33-3/F9-1A	"	0	59	38	<u>48</u>
"	Tee P33-2/NF19-1	"	0	39	19	29.5 <sup>1</sup>
"	Tee P33-2/1NF19-1	"	1	49	69	<u>59</u>
"	Tee P33-1/NF19-1	"	0	59	51	55
"	Tee P33-3/1NF19-1	"	1	44	56	<u>50</u>
"	ELL P36-1/F7-2	4	0	45	8	26
"	ELL P36-1/NF7-2	"	1	53	48	51
"	ELL P36-1/1NF7-2	"	2	50	55	<u>52.5</u>
"	ELL F16-1/F7-2	"	0	61	52	56
"	ELL F16-1/NF7-2	"	1	59	28	43.5
"	ELL F16-1/1NF7-2	"	2	51	50	<u>50.5</u>
"	ELL P38-2/F9-2	3	0	72	8	40
"	ELL P38-2/NF9-2	"	1	63	46	<u>54.5</u>
"	ELL P-38-1/F9-2 (A)	"	0	65	60	<u>62</u>
"	ELL F-48-2/1NF9-1	"	0	60	69	<u>64</u>
"	Tee P-38-1/F19-2(B)	"	0	76	26	<u>51</u>
"	" " (A)	"	1	75	58	<u>66.5</u>
"	ELL P-91-1/F7-1	4	0	71	77	<u>74</u>

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections

<u>Plan</u>	<u>Joint Number</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage.... Outer</u>	<u>Inner</u>	<u>Ave.</u>
<u>AMIDSHIPS COMPT - TRIM AND DRAIN SYSTEM</u> (continued)						
1862776 #3	ELL F16-1/F7-1	4	0	71	66	<u>68.5</u>
"	Coup P36-1/NF101-2 (A)	"	0	69	68	<u>68.5</u>
"	Coup P36-1/NF101-2 (B)	"	0	65	40	<u>52.5</u>
"	Flange P33-2/FL2-1	3	0	71	60	<u>65.5</u>
"	Tee P33-3/F19-1	"	0	59	65	<u>62</u>
"	Flange P38-2/FL2-2	"	0	75	47	<u>61</u>
"	Flange P34-1/FL2-3	"	0	85	85	<u>85</u>
"	ELL P35-2/F7-3	4	0	76	74	<u>75</u>
"	ELL P-35-3/F7-3	"	0	75	66	<u>70</u>
"	ELL P39/F9-3	3	0	80	67	<u>73.5</u>
"	ELL P39-1/F9-3	"	0	70	35	<u>52.5</u>
"	Flange P39/FL2-4	"	0	78	75	<u>76</u>
"	ELL P38-1(A)/NF9-2	"	0	62	65	<u>63.5</u>

AUXILIARY MACHINERY SPACE - A.S.W. SYSTEM

1862586	Flange P-6/FL-14	b(3) 10 USC 130	0	82	77	<u>79.5</u>
"	ELL P-6-2/F-97		0	70	44	57
"	" "		1	73	50	<u>61.5</u>
"	ELL P-6-1/F-97		0	70	54	<u>62</u>

AUXILIARY MACHINERY SPACE, L.L. - TRIM AND DRAIN SYSTEM

1862780	F1g P8-1/FL7-2	3	0	81	58	<u>69.5</u>
"	F1g P8-2/FL2-7	"	0	56	16	36
"	F1g P8-2/NFL2-7	"	1	47	1	24
"	F1g P8-2/NFL2-7	"	2	72	72	<u>72</u>
"	Coup P1-2/F4-1	"	0	64	41	52.5

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections

		IPS		Bond Percentage.....		
<u>Plan</u>	<u>Joint Number</u>	<u>Size</u>	<u>Heat</u>	<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
<u>AUXILIARY MACHINERY SPACE, L.L. - TRIM AND DRAIN SYSTEM</u>						
1862780	Coup P1-2/NF4-1	3	1	62	42	52
"	Coup P1-2/1NF4-1	"	2	64	26	45
"	Coup P1-2/4NF4-1	"	3	66	51	<u>58.5</u>
"	Coup P1-3/F4-1	"	0	52	2	27
"	Coup P1-3/NF4-1	"	1	12	2.5	7.5
"	Coup P1-3/1NF4-1	"	2	9	0	4.5
"	Coup P1-3/3NF4-1	"	3	38	21	29.5
"	Coup P1-3/4NF4-1	"	4	65	71	<u>68</u>
"	Flg P1-3/3NFL2-1	"	0	74	72	<u>73</u>
"	Flg P1-3/NFL2-1	"	0	79	*	--
"	Flg P1-4/NFL2-10	"	0	84	79	<u>81.5</u>
"	Flg P1-1/FL2-3	"	0	65	63	<u>64</u>
"	Flg P9-2/FL2-9	"	0	75	68	<u>71.5</u>
"	Flg P1-2/FL2-2	"	0	72	76	<u>74</u>
"	Tee P1-1/F22-1	"	0	56	45	<u>50.5</u>
"	"A"End Tee P8-4/F22-1	"	0	76	54	<u>65</u>
"	"B" End Tee P9-2/F22-1	"	0	62	47	<u>54.5</u>

AUXILIARY MACHINERY SPACE - TRIM AND DRAIN SYSTEM

"	Flg P8-3/FL2-6	"	0	83	70	<u>76.5</u>
"	Flg P8-3/FL2-5	"	0	75	69	<u>72</u>
"	ELL P8-1/F9-1	"	0	73	44	<u>58.5</u>
"	ELL P8-2/F9-1	"	0	70	70	<u>70</u>
"	Flg P8-4/FL2-4	"	0	83	81	<u>82</u>
"	Flg P91-3/FL7-4	"	0	65	79	<u>72</u>

\* Inaccessible due to geometry of fitting.

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections

<u>Plan</u>	<u>Joint Number</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage.....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>

AUXILIARY MACHINERY SPACE - TRIM AND DRAIN SYSTEM (continued)

1862780	Flg P91-4/FL7-3	3	0	80	78	<u>79</u>
"	Flg P91-1/FL2-8	"	0	80	80	<u>80</u>
"	ELL P91-1/F9-3	"	0	69	65	<u>67</u>
"	ELL P91-2/F9-3	"	0	75	58	<u>66</u>
"	Flg P91-2/FL7-5	"	0	83	85	<u>84</u>
"	ELL P91-3/F9-2	"	0	55	70	<u>62</u>
"	ELL P91-4/F9-2	"	0	71	81	<u>76</u>
DM263B-60-61	ELL Pc6/Pc5	4	0	57	41	<u>49</u>
"	Pc6/Pc3	"	0	70	80	<u>75</u>

ENGINE ROOM - TRIM AND DRAIN SYSTEM

1862782	Coup P-54-8/AF101-1	4	0	64	60	62
"	Coup P-54-8/NAF101-1	"	1	63	25	44
"	Coup P-54-8/ANF101-1	"	2	49	22	35
"	Coup P-54-8/ <sup>IA</sup> ANF101-1	"	3	57	42	<u>49</u>
"	Coup P-54-7/AF101-1	"	0	56	33	45
"	Coup P-54-7/NAF101-1	"	1	54	45	49.5
"	Coup P-54-7/ <sup>IA</sup> ANF101-1	"	2	57	51	<u>54</u>
"	Flg P-50-2/FL2-3	3	0	75	75	75
"	ELL P-91-1/F5-1	"	0	71	77	<u>74</u>
"	Flg P-91-1/FL2-1	"	0	67	75	<u>71</u>
"	Flg P-91-3/FL10-1	"	0	47	66	<u>56.5</u>
"	ELL P-91-2/F5-1	"	0	64	54	<u>59</u>
"	ELL P-91-3/F5-2	"	0	70	64	<u>67</u>
"	ELL P-91-2/F5-2	"	0	56	54	<u>55</u>
"	ELL P-91-8/F5-5	"	0	69	62	<u>65.5</u>

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspections

SS(N)593 P.S.A. Silver Brazed Joints - Ultrasonic Inspection

Plan	Joint Number	IPS	Heat	Bond Percentage....		
		Size		Outer	Inner	Ave.
<u>ENGINE ROOM - TRIM AND DRAIN SYSTEM (continued)</u>						
1862782	ELL P-50-1/F5-5	3	0	75	54	<u>64.5</u>
"	Flg P-50-1/FL2-2	"	0	77	61	<u>69</u>
"	Flg P-91-8/FL10-6	"	0	75	35	<u>55</u>
"	Flg P-91-7/FL10-5	"	0	71	66	<u>68.5</u>
"	ELL P-91-7/F5-4	"	0	63	56	<u>59.5</u>
"	ELL P-54-10/F4-9	4	0	61	49	55
"	ELL P-54-10/NF4-9	"	1	66	57	<u>61.5</u>
"	ELL P-54-9/F4-9	"	0	70	24	47
"	ELL P-54-9/NF4-9	"	1	70	45	<u>57.5</u>
"	Coup P-50-2/F1-1	3	0	70	66	68
"	Coup P-50-2/NF1-1	"	1	69	69	<u>69</u>
"	Coup P-50-3/F1-1	"	0	70	6	38
"	Coup P-50-3/NF1-1	"	1	51	65	<u>58</u>
"	Coup P-191-3/F1-3	"	0	77	20	48
"	Coup P-191-3/NF1-3	"	1	53	33	43
"	Coup P-191-3/1NF1-3	"	2	42	38	40
"	Coup P-191-3/2NF1-3	"	3	28	57	42.5
"	Coup P-191-3/3NF1-3	"	4	43	53	<u>48</u>
"	Coup P-191-4/F1-3	"	0	58	68	63
"	Coup P-191-4/NF1-3	"	1	56	33	44.5
"	Coup P-191-4/1NF1-3	"	2	53	31	42
"	Coup P-191-4/2NF1-3	"	3	67	60	<u>63.5</u>
"	Flg P-191-2/FL2-5	"	0	65	--	* 65
"	Flg P-191-2/FL2-5	"	1	79	43	61

\* Inaccessible due to geometry of fitting.

SS(N)593 P.S.A. Silver Brazed Joints: - Ultrasonic Inspections

		IPS		Bond Percentage.....		
<u>Plan</u>	<u>Joint Number</u>	<u>Size</u>	<u>Heat</u>	<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
<u>ENGINE ROOM - TRIM AND DRAIN SYSTEM (continued)</u>						
1862782	Flg P-191-2/FL2-5	3	2	57	67	<u>62</u>
"	Flg P-54-10/FL9-1-A	4	0	72	66	69
"	Flg P-54-10/NFL9-1-A	"	1	72	74	73
"	ELL P-91-6/F5-4	3	0	69	62	<u>65.5</u>
"	Flg P-91-5/FL10-3	"	0	78	73	75.5
"	ELL P-91-5/F5-3	"	0	65	54	<u>59.5</u>
"	Flg P54-6-A/FL18	4	0	36	69	<u>52.5</u>
"	Flg P-54-9/FL9-1	"	0	76	57	<u>66.5</u>
"	ELL P-54-5/F4-5	"	0	62	68	<u>65</u>
"	ELL P-54-6/F4-5	"	0	73	70	<u>71.5</u>
"	ELL P-54-6B/F4-46	"	0	56	47	<u>51</u>
"	ELL P-54-6A/F4-46	"	0	49	41	<u>45</u>

[illegible]

EXH 188-10

SS(N)593 P.S.A. - Silver Brazed Joints - Ultrasonic Inspections

Plan	Joint No.	IPS Size	Heat	Bond Percentage.....		
				Outer	Inner	Ave.
<u>ENGINE ROOM - 8000 GPD DISTILLER</u>						
1862892	Strainer P-1-12/F6-2	2.5	0	64	06	35
"	Strainer P-1-12/NF6-2	2.5	1	66	70	68
"	Strainer P-1-12/2NF-6-2	2.5	2	74	58	<u>66</u>
"	Strainer P1-13/F6-2	2.5	0	58	0	29
"	Strainer P1-13/NF6-2	2.5	1	36	47	41.5
"	Strainer P1-13/1NF-6-2	2.5	2	35	48	41.5
"	Strainer P1-13/2NF6-2	2.5	3	75	71	<u>73</u>
"	ELL P1-13/F5-4	2.5	0	62	45	53.5
"	ELL P1-13/NF5-4	2.5	1	73	64	<u>68.5</u>
"	ELL P1-14/F5-4	2.5	0	68	16	42
"	ELL P1-14/NF5-4	2.5	1	75	71	<u>73</u>
"	Flange P1-26/FL2-3	2.5	0	85	5	45
"	Flange P1-26/NFL-2-3	2.5	1	71	70	<u>70.5</u>
"	ELL P1-11/F5-3	2.5	0	60	64	62
"	ELL P1-11/2NF5-3	2.5	1	55	35	<u>45</u>
"	ELL P1-12/F5-3	2.5	0	75	42	58.5
"	ELL P1-12/2NF5-3	2.5	1	62	34	<u>48</u>
"	ELL P1-7/F5-2	2.5	0	58	52	55
"	ELL P1-7/NF5-2	2.5	1	74	1	37
"	ELL P1-7/2NF5-2	2.5	2	82	47	<u>64.5</u>
"	ELL P1-8/F5-2	2.5	0	57	47	52
"	ELL P1-8/NF5-2	2.5	1	69	51	60

SS(N)593 P.S.A. - Silver Brazed Joints - Ultrasonic Inspections

<u>Plan</u>	<u>Joint No.</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
1862892	ELL P1-8/2NF5-2	2.5	2	76	61	<u>69</u>
"	Strainer P1-7/1NF6-1	2.5	0	72	54	<u>63</u>
"	ELL P1-5/F5-1	2.5	0	74	72	73
"	ELL P1-5/NF5-1	2.5	1	79	79	<u>79</u>
"	ELL P1-6/F5-1	2.5	0	82	70	76
"	ELL P1-6/NF5-1	2.5	1	77	45	<u>61</u>
"	Strainer P1-6/F6-1	2.5	0	84	32	58
"	Strainer P1-6/NF6-1	2.5	1	63	53	<u>58</u>
"	Strainer P1-7/F6-1	2.5	0	58	1	29
"	Strainer P1-7/NF6-1	2.5	1	73	66	<u>69.5</u>
"	Flange P1-15/FL1-9	2.5	0	81	62	<u>71.5</u>
"	Flange P1-9/FL1-5	2.5	0	67	71	<u>69</u>
"	ELL P1-15/F5-5	2.5	0	70	56	<u>63</u>
"	ELL P1-16/F5-5	2.5	0	43	49	<u>46</u>
"	Tee P1-9/F4-2	2.5	0	60	62	<u>61</u>
"	Flange P1-5/FL1-3	2.5	0	73	78	<u>75</u>
"	Coupling P1-2/AF102-1	2.5	0	48	59	<u>53.5</u>
"	Coupling P1-1/AF102-1	2.5	0	71	66	<u>68.5</u>
"	Flange P1-1/FL1-1	2.5	0	65	82	<u>73.5</u>
"	Tee P1-4/F4-1	2.5	0	67	72	<u>69.5</u>
"	Tee P1-3/F4-1	2.5	0	58	64	<u>61</u>
"	Tee P1-2/F4-1	2.5	0	56	75	<u>65.5</u>

SS(N)593 P.S.A. - Silver Brazed Joints - Ultrasonic Inspections

<u>Plan</u>	<u>Joint No.</u>	<u>IPS Size</u>	<u>Heat</u>	<u>Bond Percentage....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
1862892	Flange P1-11/FL1-7	2.5	0	76	78	<u>77</u>
"	Flange P1-4/FL1-2	2.5	0	83	85	<u>84</u>
"	Flange P1-10/FL1-6	2.5	0	76	78	<u>77</u>
"	Tee P1-10/F221-1	2.5	0	72	52	<u>62</u>
"	Tee P1-3/F221-1	2.5	0	65	61	<u>63</u>
"	ELL P1-20/F5-10	2.5	0	68	34	<u>51</u>
"	ELL P1-26/F5-10	2.5	0	61	59	<u>60</u>
"	Flange P1-8/FL1-4	2.5	0	68	79	<u>73.5</u>
"	Flange P1-14/FL1-8	2.5	0	80	88	<u>84</u>
"	Flange P1-20/FL2-4	2.5	0	85	85	<u>85</u>
"	ELL P1-17/F5-9	2.5	0	68	69	<u>68.5</u>
"	ELL P1-25/F5-9	2.5	0	60	69	<u>64.5</u>
"	Flange P1-25/FL2-2	2.5	0	78	80	<u>79</u>
"	Tee P1-16/F4-2	2.5	0	66	64	<u>65</u>
"	Tee P1-17/F4-2	2.5	0	73	48	<u>60.5</u>

The foregoing list, made 4 May 1963 from prime shop and inspection records, indicates that of the 161 distinct joints 151 were accepted on the first ultrasonic inspection, either as found or as first brazed. Some of these, although accepted, were later cut out and replaced as interference. For a total of 161 finished joints, 247 heats and ultrasonic tests were required.

$$\frac{\text{Final joints}}{\text{Total heats}} = \frac{161}{247} = 65\%$$

F = ORIGINAL FITTING UNDISTURBED OR REUSED  
AF = NOT SHOWN ON PLAN, BUT FOUND IN PLACE ON ARRIVAL  
NF = NEW FITTING PUT IN OLD JOINT DURING PSA  
NAF = NEW FITTING PUT IN OLD ADDITIONAL FITTING DURING PSA  
ANF = NEW JOINT CREATED DURING PSA, NOT SHOWN ON DWG.

*Exhibit 188-14*

SS(N)593

P-1 welded piping joints, all sizes, which were made in Air Conditioning, Auxiliary Salt Water, and Trim & Drain Systems during the post-shakedown availability.

JOINT	O.D. SIZE	HEAT NO.	RT READING
<u>FORWARD ROOM - Trim &amp; Drain System - Dwg. 1862775</u>			
F25 - F1 (v)	4.5	1	OK 10/26
F26 - F2	4.5	1	Slag 11/30
		2	OK 12/20
F27 - F1 (w)	3.5	1	OK 10/26
FL1 - F2 (x)	4.5	1	OK 10/27
P13-1 - F2	4.5	1	OK 10/26
F1 - P13-1 (z)	4.5	1	Slag 10/26
		2	OK 10/31
F2 - F25 (y)	4.5	1	OK 10/27
P13-1 - F26	4.5	1	Slag 11/15
		2	OK 11/21
<u>AUXILIARY MACH'Y SPACE - Trim &amp; Drain - Dwg. 1943414</u>			
P16 - 46L/Pc 6	4.5	1	Slag 10/31
		2	OK 11/7
<u>AUXILIARY MACH'Y SPACE - Aux. Salt Water - Dwg. 1862586</u>			
P1 - FL5	b(3) 10 USC 130	1	Crack & Porosity 2/18
		2	Porosity 2/21
		3	OK 2/22
P1 - F1		1	Porosity 2/18
		2	Porosity 2/21
		3	OK 2/22
<u>ENGINE ROOM - Air Cond. Salt Water - Dwg. DLI 15040</u>			
FL2 - F25	5.563	1	Porosity & Crack 1/24
		2	Porosity 1/31
		3	OK 2/1
F67 - F65	5.563	1	Slag & Porosity 12/26
		2	Porosity 12/31
		3	OK 1/4
F67 - F25	5.563	1	Porosity 12/26
		2	Porosity 12/31
		3	OK 1/4
F67 - F67A	5.563	1	OK 1/30
F28 - F67	5.563	1	OK 1/28

NOTE - (v) (w) (x) (y) (z) were silver brazed fittings on arrival.

EXH189-1

JOINT	O.D. SIZE	HEAT NO.	RT READING
<u>ENGINE ROOM - AIR COND. SALT WATER - Dwg. 1862718</u>			
FL1 - F13	5.5	1	Slag 11/29
		2	Porosity 11/29
		3	OK 12/5
FL2 - Ext. Nipple	5.5	1	Porosity 10/24
		2	OK 10/30
FL2 - F25	5.5	1	Lack of Penetration 10/24
		2	OK 10/29
FL2 - P27	5.5	1	Slag 1/29
		2	OK 2/2
F13 - Added Nipple	5.5	1	OK 10/23
F13 - P28	5.5	1	OK 2/2
F13 - P28-1	5.5	1	Crack 12/21
		2	Slag 12/28
		3	Porosity= Crack 12/31
		4	Crack & Porosity 1/16
		5	OK 1/21
P18 - F18	6.625	1	Burn thru 1/28
		2	OK 1/30
F25 - Ext. for	5.5	1	OK 1/17
F25 - To Nipple	5.5	1	OK 1/24
F25 - F25 E	5.5	1	Crack-Undercut-Poor Flow 1/29
		2	OK 2/5
F25 F26	5.5	1	Slag 12/17
		2	OK 12/21
F25 - P28	5.5	1	OK 11/24
F25 - F67	5.5	1	OK 1/28
F26 - F67	5.5	1	Undercut 2/3
		2	OK 2/6
P27 - F26	5.5	1	OK 10/25
P28-1 - F25	5.5	1	OK 12/21
F67 - P28	5.5	1	OK 2/4
F67 - F67	5.5	1	OK 10/13

The foregoing list, made 4 May 1963 from prime shop records, supersedes a similar list submitted by Code 303-E1 on 3 May. It includes 35 distinct joints, 18 of which required repairs subsequent to first radiographic examination and were thereafter re-radiographed and accepted.

Acceptable joints =  $\frac{35}{62}$  = 56%  
Total attempts

This list excludes those P-1 joints in the auxiliary steam system which were the only other P-1 joints welded and radiographed during the post-shakedown availability.

SS(N)593

Silver brazed piping joints which were remade in filling lines outboard of hull stops and outboard of pressure hull, not a part of hull integrity survey, showing results of ultrasonic inspections. Both lines in No. 3A main ballast tank.

<u>Plan</u>	<u>Joint Number</u>	<u>IPS</u>	<u>Heat</u>	<u>Bond Percentage....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
<u>LUBE OIL FILLING LINE</u>						
						<u>b(3) 10 USC 130</u>
1862638	ELL "A" END P1-4/F38		0	33	21	27
"	" " " " "		1	43	12	27.5
"	" " " " "		2	47	47	<u>47</u>
"	ELL "B" END P1-4/F38		0	25	46	35.5
"	" " " " "		1	51	55	53
"	" " " " "		2	56	47	<u>51.5</u>
<u>FUEL OIL FILLING LINE</u>						
1862805	Coup "A" End P39/F6	2	0	52	78	65
"	Coup " " " "	2	1	76	49	<u>62.5</u>
"	Coup "B" End P39/F6	2	0	80	0	40
"	" " " " "	2	1	81	68	<u>74.5</u>
"	Coup "A" added P39/F6	2	0	77	70	<u>73.5</u>
"	Coup "B" added P39/F6	2	0	63	56	<u>59.5</u>

The foregoing list, made 4 May 1963 from prime shop and inspection records, indicates that of these six distinct joints two were satisfactorily brazed on the first attempt and four required a total of six additional heats prior to acceptance.

$$\frac{\text{Acceptable heats} - 6}{\text{Total heats} - 12} = 50\%$$

EXH 190

SS(N)593

Silver brazed piping joints which were remade in diesel generator cooling system because of design change, not a part of hull integrity survey, showing results of ultrasonic inspections. Located in forward compartment, lower level.

<u>Plan</u>	<u>Joint Number</u>	<u>IPS</u>	<u>Heat</u>	<u>Bond Percentage....</u>		
				<u>Outer</u>	<u>Inner</u>	<u>Ave.</u>
DM261B-505-62	ELL Pcl-4/NF5-3	2.5	0	54	70	<u>62</u>
"	ELL Pcl-3/NF5-1	2.5	0	57	77	<u>67</u>
"	Tee Pl-1/NPc-9	2.5	0	68	67	<u>67.5</u>
"	Tee Pl-2/NPc-9	2.5	0	52	64	<u>58</u>
"	ELL Pcl-2/NF-5-1	2.5	0	57	66	<u>61.5</u>
"	ELL Pl-5/NF-5-3	2.5	0	71	61	<u>66</u>
"	Flange Pcl-5/FL-1	2.5	0	77	69	<u>73</u>

The foregoing list, made 4 May 1963 from prime shop and inspection records, indicates that all these seven joints were satisfactorily brazed on the first attempt.

$$\frac{\text{Acceptable heats}}{\text{Total heats}} = \frac{7}{7} = 100\%$$

EXH 191

USS THRESHER (SS(N)593)

KEY EVENTS - BUILDING PERIOD

1. KEEL LAYING DATE	5/28/58
2. SHIP ACCEPTED AUX. SEA WATER (AFT)	2/16/61
3. SHIP ACCEPTED MAIN SEA WATER	2/16/61
4. SHIP ACCEPTED AUX. SEA WATER (FWD)	3/10/61
5. SHIP ACCEPTED H.P. AIR SYSTEM	3/10/61
6. INITIAL CRITICALITY	3/10/61
7. POWER RANGE TESTING COMPLETE	3/14/61
8. AIR CONDITIONING SALT WATER SYSTEM	4/25/61
9. HYDRAULIC SYSTEMS	4/25/61
10. DAY 1ST SEA TRIAL STARTED	4/30/61
11. DAY 1ST SEA TRIAL COMPLETED	5/2/61
12. DAY 2ND SEA TRIAL STARTED	5/22/61
13. DAY 2ND SEA TRIAL COMPLETED	5/26/61
14. DAY 3RD SEA TRIAL STARTED	7/8/61
15. DAY 3RD SEA TRIAL COMPLETED	7/12/61
16. DAY 4TH SEA TRIAL STARTED	7/25/61
17. DAY 4TH SEA TRIAL COMPLETED	7/27/61
18. COMMISSIONING	8/3/61

EXH 192-1

USS THRESHER (SS(N) 593)

SHOCK HARDENING AVAILABILITY - (E.B.)

ARRIVE E. B.	4/16/62
IN DOCK	4/19/62
OUT OF DOCK	5/9/62
SOUND TRIALS (FORT POND BAY)	5/19/62
TO SEA	5/21/62

PATCH HULL AVAILABILITY

ARRIVE E. B.	6/6/62
IN DOCK	6/6/62
OUT OF DOCK	6/8/62
TO SEA	6/8/62

SHOCK TRIALS

1ST SHOCK	6/17/62
2ND "	6/19/62
3RD "	6/21/62
4TH "	6/23/62
5TH "	6/26/62
6TH "	6/29/62

Portsmouth NSY Personnel arrive at Key West (ship there)	6/13/62
" " " left Key West	7/2/62
Ship was expected to leave Key West about	7/3/62

Exhibit 192-2

USS THRESHER (SS(N)593)

KEY EVENTS PSA

1. ARRIVED YARD	7/11/62
2. ARRIVAL CONFERENCE	7/20/62
3. START OF AVAILABILITY	7/23/62
4. DOCK	9/5/62 - 1/16/63
5. STEAM OPERATIONS (SHORE STEAM)	2/23/63 - 2/28/63
6. HOT OPERATIONS	2/13/63 - 2/19/63
7. CRITICALITY	3/15/63
8. POWER OPS	3/16/63 - 3/17/63
9. FAST CRUISE	3/23/63 - 3/26/63
10. FAST CRUISE	3/31/63 - 4/1/63
11. ACOUSTIC SOUND BASIN	4/1/63 - 4/4/63
12. DOCK	4/4/63 - 4/8/63
13. SEA TRIALS	0800 4/9/63

Exhibit 192-3

Illegible Copy Provided

Exhibit 193

6-71A

SHIP GROUPS		
	CODE	
Structural	945	Chart 58 11-17-23-26
Mechanical	946	Chart 58 06-31-37-61-94
Outfitting	947	Chart 58 38-56
Electrical	948	Chart 58 11-49
Service	949	Chart 58 04-71-72-99

DATE 1 MAY 1963	APPROVED  CAPTAIN, USN PRODUCTION OFFICER	MANAGEMENT BUREAU BUREAU OF SHIPS	PORTSMOUTH NAVAL SHIPYARD PORTSMOUTH, NEW HAMPSHIRE	PRODUCTION DEPARTMENT	CHART NO. 5
--------------------	---------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------	--------------------------------------------------------	-----------------------	-------------

CHANGE NO. 92

EXH 193

Illegible copy provided

8-9-12-4

78,125  
69,919  
8.206 410<sup>7</sup><sub>293</sub>

- March - 1963

	636	620	606	605	593	555	569	<sup>Dayfish</sup> 350 Total
1	1066	1150	245	694	431	111	228	4272
2	525	838	111	418	458	10	9	2417
3	186	236	67	126	364	4	1	998
4	1151	1127	159	704	336	106	254	53 4218
5	1032	1108	249	695	279	94	272	71 4194
6	1102	1174	315	705	367	113	277	67 4423
7	1095	1102	307	704	302	123	264	63 4259
8	1087	1110	314	667	314	117	252	86 4216
9	534	993	212	443	332	1	8	2 2548
10	247	383	152	133	210	2	-	- 1200
11	1120	1078	254	683	248	117	242	92 4095
12	1004	1063	239	638	232	87	259	89 3866
13	1117	1151	263	697	213	125	265	140 4277
14	1085	1198 <sup>13711</sup>	272	706	203	109	263	153 4308
15	1087	1220	277	700	188	102	273	163 4282
16	533	1068	98	397	145	7	12	64 2352
17	192	359	81	110	<sup>129</sup> (4751) 136	2	5	19 901
18	1119	1157	206	684	136	116	261	173 4199
19	1135	1164	200	691	199	117	270	194 4223
20	1151	1225	229	731	189	123	260	176 4344
21	1172	1178	239	729	154	130	276	178 4287
22	1144	1200	230	694	108	114	272	185 4205

EX194-1

	636	620	606	605	593	555	569	540	Total
23	540	1090	103	464	38	4	49	49	2359
24	281	470	82	89	15	1	23	28	894
25	1180	1188	236	723	35	144	299	172	4225
26	1132	1203	247	707	111	127	282	138	4201
27	1160	1198	218	781	160	133	285	216	4326
28	1165	1136	219	713	221	126	284	193	4322
29	1116	1273	241	746	230	112	259	217	4434
30	537	1051	252	491	64	4	59	12	2491
31	164	493	210	97	19	-	28	1	1023
	27259	31384	6527	17560	1679	2481	5791	2994	-
	160788	599136	65170	473736	4751	7928	21493	82	-
	187947	630520	660697	491296	78123	10409	27244	3074	-
		10407			84555				
		640927							

Exhibit 194-2

April 1963

	636	620	606	605	593	553	569	540	Total
1	1171	1072	251	731	45	122	257	220	4116
2	1156	1133	281	720	48	146	268	209	4247
3	1159	1192	263	744	43	123	296	221	4296
4	1149	1107	246	717	143	115	289	204	4228
5	1112	1108	260	722	193	110	269	208	4227
6 <sup>54</sup>	466	1000	276	514	158	4	31	53	2525
7	140	487	221	89	135	-	-	8	1088
8	1153	1076	251	707	86	90	286	240	4137
9	1146	1105	294	739	13	97	318	246	4230
10	1159	1127	295	716	12	111	290	268	4225
11	1144	1139	230	761	5	113	325	287	4274
12	1119	1137	151	767	8	96	327	290	4122
13 <sup>54</sup>	410	520	72	546	6	5	36	39	1767
14 <sup>50</sup>	16	13	61	13	1	5	11	1	126
15	1160	1043	103	729	4	100	350	265	3997
16	1145	1164	143	771	2	101	340	319	4238
17	1133	1159	156	803	5	90	353	317	4274
18	1133	1174	168	783	2	104	343	357	4412
19	1099	1067	145	779	4	107	318	322	4100
20	411	977	142	358	3	3	37	34	1988
21	54	246	75	113	-	1	1	1	495
22	1272	1021	117	482	4	99	352	337	3963
	208,140	652,070	665,066	504,817		12,128			EXH 1957

	626	620	606	605	597	555	569	540	
	208140	652070	665066	504817		12728			
23	1271	1106	173	457	2	109	381	328	4072
24	831	1026	198	342	-	68	179	319	3247
25	1280	1169	150	395	1	103	315	360	4069
26	1197	1130	157	494	4	105	357	309	4048
27	462	942	89	406	-	2	89	71	2088
28	75	261	35	140	-	-	38	18	587
29	1253	987	128	612	2	116	324	293	3994
30	1282	1100	160	685	6	102	317	346	4287
	27,558	28,788	5311	16835		2337			
	18,110	18,223	3867	12331		1629			
	9,388	9,965	1444	4484		708			

Exhibit 195-2

	626	620	606	605	597	555	569	540	
	208140	652070	45066	504817		12728			
23	1271	1106	173	457	2	109	381	328	4072
24	831	1026	198	342	-	68	179	319	3247
25	1280	1169	156	395	1	103	315	360	4069
26	1197	1130	157	494	4	105	357	309	4048
27	462	942	89	406	-	2	89	71	2088
28	75	261	55	140	-	-	38	18	587
29	1253	987	128	612	2	116	324	293	3994
30	1282	1100	160	685	6	102	317	346	4287
	27,558	28,788	5311	16835		2337			
	18,170	18,823	3867	12331		1629			
	9,388	9,965	1444	4484		708			

Exhibit 195-2

U. S. S. SKYLARK ASR20 SHAFT NO(S). E DATE 10 APR 11 1963  
En route from Boston OPERATING AREA to \_\_\_\_\_

TIME ZONE DESCRIPTION +5 Clocks set back or ahead \_\_\_\_\_ hrs. \_\_\_\_\_ min., at \_\_\_\_\_[illegible]

EXH 198-1

**3ND-P&PO**

EXH 195-2

R.R. Venkatesh (TWS) USA

URNS VS KNOTS USS SKYLARK (ASR-20)

URNS	KNOTS	URNS	KNOTS	URNS	KNOTS	URNS	KNOTS	URNS	KNOTS
1	1.1	31	3.9	61	7.8	91	11.7	121	14.4
2	1.2	32	4.0	62	7.9	92	11.8	122	14.5
3	1.3	33	4.1	63	8.0	93	11.9	123	14.6
4	1.5	34	4.3	64	8.2	94	12.0	124	14.7
5	1.6	35	4.4	65	8.3	95	12.1	125	14.8
6	1.7	36	4.5	66	8.4	96	12.2	126	14.9
7	1.8	37	4.6	67	8.6	97	12.3	127	15.0
8	1.1	38	4.8	68	8.7	98	12.35	128	15.1
9	1.1	39	4.9	69	8.8	99	12.4	129	15.2
10	1.2	40	5.1	70	9.0	100	12.5	130	15.3
11	1.3	41	5.2	71	9.1	101	12.6	131	15.35
12	1.5	42	5.3	72	9.2	102	12.7	132	15.4
13	1.6	43	5.4	73	9.4	103	12.8	133	15.5
14	1.7	44	5.5	74	9.5	104	12.9	134	15.6
15	1.8	45	5.7	75	9.6	105	13.0	135	15.7
16	2.0	46	5.8	76	9.7	106	13.1	136	15.8
17	2.2	47	6.0	77	9.8	107	13.2	137	15.9
18	2.3	48	6.1	78	10.0	108	13.3	138	16.0
19	2.4	49	6.2	79	10.2	109	13.4	139	16.1
20	2.5	50	6.3	80	10.3	110	13.45	140	16.2
21	2.6	51	6.5	81	10.4	111	13.5	141	16.25
22	2.7	52	6.6	82	10.6	112	13.6	142	16.3
23	2.9	53	6.7	83	10.7	113	13.7	143	16.4
24	3.0	54	6.9	84	10.8	114	13.8	144	16.5
25	3.1	55	7.0	85	10.9	115	13.9	145	16.6
26	3.2	56	7.1	86	11.0	116	14.0	146	16.7
27	3.4	57	7.2	87	11.2	117	14.1	147	16.8
28	3.5	58	7.4	88	11.3	118	14.2	148	16.9
29	3.6	59	7.5	89	11.4	119	14.25	149	17.0
30	3.8	60	7.6	90	11.5	120	14.3	150	17.1

Ex 197

**NAVAL MESSAGE**  
OPNAV FORM 2110-28 (10-58)

RELEASED BY		DRAFTED BY		PHONE EXT. NR.	
DATE 10 APR 63		TOR/TOD 21297/4253KCS/RC		ROUTED BY	
CHECKED BY					
MESSAGE NR.	DATE/TIME GROUP (GCT) 101925Z	PRECEDENCE	FLASH	EMERGENCY	OPERATIONAL IMMEDIATE
		ACTION			0000
		INFO			

FROM: COMSUBLANT

TO: COMSERVLANT

INFO: DEPCOMSUBLANT COMSUBFLT TWO COMSUBDEVGRU TWO USS SKYLARK  
USS RECOVERY USS SUNBIRD

UNCLAS

1. USS THRESHER CONDUCTING DEEP DIVE SEA TRIALS WITH SKYLARK  
ESCORT AT <sup>b(1)</sup> COMMUNICATIONS LOST AT 101417Z.
2. REQUEST DIVERT RECOVERY TO ASSIST SKYLARK IN SEARCH FOR THRESHER

WJ/RC

DISTRIBUTION:

EXH 198

UNCLASSIFIED

DATE/TIME GROUP  
101925Z/APR 63

Exh 199-1  
April 18, 1963

Dear Capt. Hecken

I want to express in writing the thoughts and feelings I wished to convey in our telephone conversation of Wednesday morning. The emotional circumstances under which we spoke may not have adequately fulfilled both our purposes.

Like most Navy wives, I do not understand all the technical terms and phraseology used by so many people, radio, television, and newspapers in discussing loss of Shresher. All the ideas and ~~opinions~~ and chit chat regarding this tragedy have been confusing to myself, and I am sure to other families who lost loved ones.

Selected interviews of one of your young lieutenants and Scarborough's Mate regarding Shresher's part in the

Exh 199-1

Exh 199-2

2  
loss have been eagerly listened to, and  
in the minds of some, may have  
been the bases for forming more  
misleading ideas.

I do want you to know  
however that I have compassion  
in my own heart and I feel certain  
all others who have suffered loss on  
Shresher feel that you and Skylark  
were there, and that your performance  
was being done in assisting Shresher  
during her sea trials.

I am personally consoled  
by the thought that you exerted  
~~every~~ possible means at your  
disposal to render aid and assistance  
to Wes and his ship.

If consolation can be found  
in mere words, I know that you

Exh 199-2

3

Commanding Officer of Skylark and Wes  
as Commanding Officer of Threshw  
fully and capably assumed your  
responsibilities of Command and you  
can continue to feel proud of your  
Ship and your crew.

Bless you

Gene Harvey

Exh 199-3

36  
FCSS10/01/wpf  
1650  
Ser 669

**8 APR 1963**

FIRST ENDORSEMENT on DEPCOMSUBLANT ltr DEP N1/2407 of 2 May 1963

From: Commander Submarine Squadron TEN

To: Commanding Officer, USS SKYLARK (ASR20)

Subj: Commendable performance of USS SKYLARK (ASR20),  
21-22 March 1963

1. Forwarded with pleasure.

b(6)

WALTER L. SMALL

COMMANDER SUBMARINE FORCE  
UNITED STATES ATLANTIC FLEET  
FLEET POST OFFICE  
NEW YORK, NEW YORK

FF4-12

1650

Ser: DEP NL/ 2407

2 APR 1963

From: Deputy Commander Submarine Force, U.S. Atlantic Fleet  
To: Commanding Officer, USS SKYLARK (ASR20)  
Via: Commander Submarine Squadron TEN

Subj: Commendable performance of USS SKYLARK (ASR20), 21-22 Mar 1963

Ref: (a) COMDESEVGRU TWO ltr ser 160 of 27 Mar 1963

1. Reference (a) was noted with interest.
2. DEPCOMSUBLANT congratulates SKYLARK's Commanding Officer and personnel for their outstanding performance in a difficult task under arduous conditions. Well Done.

b (6)

P. A. BESHANY  
By direction

Exh 200-2



**DESTROYER DEVELOPMENT GROUP TWO**  
**UNITED STATES ATLANTIC FLEET**  
**NEWPORT, RHODE ISLAND**

CDDG2/60:cn

1600

Ser: 100

**27 MAR 1963**

**From:** Commander Destroyer Development Group TWO  
**To:** Commander Submarine Squadron TEN

**Subj:** Commendable performance of USS SKYLARK (ASR20), 21-22 March 1963

**Ref:** (a) COMSUBFLOT TWO msg 201606Z MAR 63 (NOTAL)  
(b) COMDESDEVGRU TWO MOVORD 9-63 ser 052 of 20 Mar 1963 (NOTAL)

1. Commanding Officer, USS SKYLARK (ASR20) reported to Commander Destroyer Development Group TWO and conducted operations on 21-22 March 1963 in accordance with references (a) and (b).
2. On short notice and for the first time, SKYLARK handled a large and complicated target array for the MK 37 MOD 0 torpedo test firings by USS HUGH PURVIS (DD709). Despite a series of material problems that were beyond her control, and under adverse conditions of wind and sea, SKYLARK exhibited the highest degree of ingenuity, tenacity, and superb seamanship during a 16-hour work day. The cheerful response and can-do attitude were exemplary.
3. Commander Destroyer Development Group TWO is grateful for the services of SKYLARK, and considers that her commendable performance reflects credit on the Commanding Officer, LCDR S. HECKER, USN, and on his officers and crew.
4. The project which Destroyer Development Group TWO is prosecuting should result in an excellent target that can be used by submarines as well as destroyers. Observers from the Submarine Force are welcome to ride with us in future firing exercises.

b(6)

JOHN E. DACEY

Copy to:  
COMCRUDESANT  
DEPCOMSUBLANT  
COMSUBFLOT TWO  
COMSUBDEVGRU TWO  
CO, USS SKYLARK (ASR20)

Exh 200-3

USS SKYLARK  
Received JUL 11 1962  
(date)

FCSS10/01/ski  
5041/2  
Ser 1434

9 JUL 1962  
SECOND ENDORSEMENT on COMSUBFLOT SIX ltr 3590 ser 185 of  
18 Jun 1962

From: Commander Submarine Squadron TEN  
To: Commander Submarine Force, U.S. Atlantic Fleet  
Subj: Operational Readiness Inspection of USS SKYLARK (ASR20)  
1. Forwarded.

F. D. WALKER, Jr.

Copy to:  
DEPCOMSUBLANT (Comp)  
COMSUBFLOT SIX  
CO USS SKYLARK (ASR20)

ASR20/AHC:lwg  
3590  
Ser: 245  
2 July 1962

**FIRST ENDORSEMENT on COMSUBFLOT SIX ltr ser.185 of 18 June 1962**

**From: Commanding Officer, USS SKYLARK (ASR-20)**  
**To: Commander Submarine Force, U. S. Atlantic Fleet**  
**Via: Commander Submarine Squadron TEN**

**Subj: Operational Readiness Inspection of USS SKYLARK (ASR-20);  
report of**

1. The 100 yard error on the fourth drop is believed to be in error, in that only 900 feet of seven-inch nylon was utilized to each leg, although a four-degree error in bearing was accepted which would constitute an error of approximately 100 feet. Due to the radius of the moor, this error was felt to be acceptable.
2. The type seal utilized, was elected because of the bell operator's reporting a fouled seat due to the non-spin line being across the seat. Although the diver reported clear, when the ship was moved over in the moor to give the proper angle for the Rescue Chamber the false seat must have fouled. It was cleared by "taking a strain" on the non-spin line, but it was felt that a seal under the gasket was in order as an "insurance factor".
3. Divers were delayed in that the same capstan (port quarter), which was utilized in lowering the false seat was also utilized for raising and lowering the divers stage. This necessitated clearing the capstan from the false seat evolution to the diving evolution. Methods are being studied to alleviate this situation, and to speed up the HeO2 diving.
4. A portable line is being manufactured to close opening left by diving gate removal during these operations.
5. As funds are available new football helmets are being ordered.
6. The sliding wire used in conjunction with the back haul rope has been discontinued.

**C. N. OSBORNE**

**Copy to:  
COMSUBFLOT SIX**

*Exh 201-2*

PD6:wm  
3590  
Serial 185  
18 June 1962

From: Commander Submarine Flotilla SIX  
To: Commander Submarine Force, U. S. Atlantic Fleet  
Via: (1) Commanding Officer, USS SKYLARK (ASR-20)  
(2) Commander Submarine Squadron TEN

Subj: Operational Readiness Inspection of USS SKYLARK (ASR-20);  
report of

Ref: (a) COMSUBFLOT SIX NOTICE 3590 of 11 Apr 1962

Encl: (1) Report of Specific Exercises and General Comments -  
ORI USS SKYLARK (ASR-20)  
(2) Score Sheet - USS SKYLARK (ASR-20)

1. An Operational Readiness Inspection of the USS SKYLARK (ASR-20) was conducted off New London, Connecticut on 5 June 1962 as scheduled by reference (a).
2. SKYLARK got underway at 0805Q from pier at the U. S. Naval Submarine Base, New London, Connecticut. General drills were conducted enroute to the operating area.
3. A four point moor was made and a false seat exercise successfully conducted in 40 fathoms of water in operating area 24-B about 30 miles SSE of Montauk Point. SKYLARK required 5 hours and 01 minute from dropping the first leg of the four point moor until bell personnel were on deck following the bell run.
4. Enclosures (1) and (2) summarize exercises conducted. An overall grade of GOOD is assigned for this inspection.

USS SKYLARK  
Received JUN 29 1962

G. C. COLE

Exh 201-3

**REPORT OF SPECIFIC EXERCISES AND GENERAL COMMENTS  
ORI USS SKYLARK (ASR-20)**

**1. Summary of Evolutions Conducted.**

<u>EVOLUTION</u>	<u>GRADE</u>
Duty Section Underway	GOOD
Navigation & Low Visibility Piloting	EXCELLENT
Steering Casualty	EXCELLENT
Man Overboard	EXCELLENT
Unidentified Submarine Contact	GOOD
Rescue & Assistance	GOOD
Fire	GOOD
Use of Emergency Generator	EXCELLENT+
Medical	EXCELLENT
Submarine Rescue	GOOD

**2. Submarine Rescue (S-4-3) - False Seat Exercise.** The false seat exercise was conducted in 40 fathoms of water at Lat. 40-56N Long. 71-35.5W approximately 30 miles SSE of Montauk Point, Long Island.

a. Fifty minutes were required to rig for the four point moor. SKYLARK used the cloverleaf pattern for dropping. Ten shots of chain were used with a radius of moor of 620 yards on an axis of 125°. One hour and thirty six minutes elapsed from dropping of the first anchor until taut in the moor. The drop point of the fourth anchor was missed by about 100 yards. Several minutes were unavoidably lost when a shaft coupling carried away on the workboat and necessitated passing the port quarter leg to the whaleboat to run.

b. Divers were not dressed by the time the false seat was on the bottom and some eighteen minutes of avoidable delay occurred.

c. The bell operations proceeded smoothly. A successful seal was made by blowing lower compartment under the gasket. In accordance with COMSUBANT NOTICE 3500 of 16 May 1962, the lower hatch was not opened. The bell was at 240 feet depth when on the false seat. Bell personnel stepped back aboard SKYLARK at 1844Q, 5 hours and 01 minute after the first anchor was dropped.

d. The following items were noted wherein safety could be roved:

(1) Men were noted standing on the rail and working on top of the spuds without life jackets and tending lines.

(2) A portable life line is needed in way of the opening left by the portable bulwark.

(3) One coxswain was observed without life jacket.

(4) Recommend use football helmets with face guards for the ball operators vice the helmet liners employed.

(5) Question safety of sliding wire anchor point for preventer on side of rescue bell due to multiplication of forces involved owing to shallow angles subtended by the wire.

(6) Threaded pin shackle was used to secure the bell backhaul wire to the lifting ring vice bolt, nut, and cotter key (action on this item to be withheld pending COMSUPLANT decision).

Exh 201-5  
ENCLOSURE (1)

**SEAMANSHIP EXERCISE (S-4-S) SUBMARINE RESCUE - FALSE  
SEAT EXERCISE - USS SKYLARK**

	<u>Maximum Score</u>	<u>Assigned Score</u>
<b>1. Deck Seamanship</b>	<b>30</b>	<b>24</b>
a. Preparation and rigging	5	4
b. Laying of moor	5	5
c. Centering in moor	5	4
d. Handling divers	5	4
e. Handling bell	5	3
f. Recovering moor	5	4
<b>2. Laying the moor (1 hour and 40 minutes standard).</b>	<b>30</b>	<b>23</b>
a. Maneuvering and dropping	15	12
b. Connecting and Centering, including small boat seamanship	15	11
<b>3. Rescue Phase</b>	<b>30</b>	<b>24</b>
a. Diving operations	10	7
b. Bell operation	20	17
<b>4. Safety</b>	<b>10</b>	<b>6</b>
<b>TOTAL</b>	<b>100</b>	<b>77</b>

COMMANDER SUBMARINE FLOTILLA SIX  
Care of Fleet Post Office  
New York, New York

TO: N1:tmm

3590

Serial: 051

PR 18 1963

Unclassified

From: Commander Submarine Flotilla SIX  
to: Commander Submarine Force, U.S. Atlantic Fleet  
1a: (1) Commanding Officer, USS SKYLARK (ASR20)  
(2) Commander Submarine Squadron TEN

Subj: Operational Readiness Inspection USS SKYLARK (ASR20)

Ref: (a) COMSUBFLOT SIX NOTE 3590 ser 455 of 29 Nov 1962

Encl: (1) Report of specific exercises and general comments  
(2) Score sheet, Submarine Rescue Exercise

1. An Operational Readiness Inspection of USS SKYLARK (ASR20) was conducted in Narragansett Bay Operating Area 32B on 3, 4 and 5 April 1963 in accordance with reference (a).

2. The ship was exercised at general drills while proceeding to the OpArea on 3 April and while returning to New London on 5 April. A submarine rescue exercise (S-4-S) was conducted in approximately 305 feet of water commencing at 032050Z April 1963.

3. Items requiring particular attention and correction are:

- a. Greater use of sound powered phone circuits during ship evolutions and general emergencies.
- b. Report soundings to Officer of the Deck when approaching or operating in shoal water.
- c. Review instructions and procedures concerned with unidentified submarine sightings and correct reporting procedures.
- d. Improve the communications between the boats and the ship when laying and recovering a moor. More powerful portable radio equipment may be required.

4. The four point moor commenced at 1156R 3 April. Low visibility due to heavy fog delayed operations and the ship was taut in the moor at 0820R 4 April. Ball operations were completed at 1135R. Gale force winds and rough seas delayed recovery of the moor until the morning of 5 April 1963. The delays were beyond the control of the ship.

DOWNHILL AND UP HILL INTERVALS

Unclassified

FHX202-1

FD6:N1:tm  
3590

APR 18 1963

Unclassified

5. A grade of EXCELLENT is assigned for this inspection.

T. R. MC CANTS  
Chief of Staff

Copy to:  
DEPCOMSUBLANT

Exh 202-2

Unclassified

Enclosure (1)

SPECIFIC EXERCISES AND GENERAL COMMENTS

OPERATIONAL READINESS INSPECTION USS SKYLARK (ASR20)

1. Summary of Evolutions Conducted.

<u>EVOLUTION</u>	<u>GRADE</u>
Duty Section Underway	OUTSTANDING
Navigation and Low Visibility Plotting	EXCELLENT
Man Overboard	EXCELLENT
Radiation Safety Drill	EXCELLENT
Communications	GOOD
Extinguishing Fires	EXCELLENT
Steering Casualty	OUTSTANDING
Medical Casualties	EXCELLENT
Submarine Rescue	EXCELLENT

2. Submarine Rescue (S-4-S). The exercise was conducted in the Narragansett Bay Operating Area 32B in 305 feet of water. When the moor was layed the wind and sea were from the northeast. Sea state was two and wind force was 15 knots. There was a sub-surface current of 2 knots from the east-northeast.

a. A modified individual clover leaf pattern was employed to lay the moor. The pattern was designed to orientate each leg toward the center of the moor. After the four legs were down, heavy fog prevented connecting the nylon mooring line to the spuds. The ship remained in the vicinity of the spuds until 0710R 4 April when the fog lifted enough to resume operations. The ship was taut in the moor at 0820R.

b. Deck seamanship was excellent. The deck force was well organized and performed all functions smoothly.

c. Diving operations were not attempted and the exercise was successfully completed without using a diver.

d. The rescue chamber left the surface at 1037R and made a good seal on the first attempt. The rescue chamber was on the surface at 1135R.

e. The weather worsened as the moor was being recovered and had reached gale proportions after three (3) legs were in. It was necessary to ride out the gale until the morning of 5 April and recover the last leg when the wind and sea began to abate.

f. A grade of EXCELLENT is assigned for this exercise.

Enclosure (1)

Unclassified

Exh 202-3

Unclassified

Enclosure (2)

SEAMANSHIP EXERCISE (S-4-S) SUBMARINE RESCUE

FALSE SEAT EXERCISE

	<u>MAXIMUM SCORE</u>	<u>ASSIGNED SCORE</u>
1. Deck Seamanship	30	27
a. Preparation and rigging	5	5
b. Laying of moor	5	5
c. Centering in moor	5	3
d. Handling divers	5	5
e. Handling bell	5	4
f. Recovering moor	5	5
2. Laying the moor (1 hour and 40 minutes standard).	30	28
a. Maneuvering and dropping	15	15
b. Connecting and Centering, including small boat seamanship.	15	13
3. Rescue Phase	30	30
a. Diving operations	10	10
b. Bell operation	20	20
4. Safety	10	8
TOTAL	100	93

Enclosure (2)  
Unclassified

Exh 202-4

*Return to 402A*

COMMANDER SUBMARINE FORCE  
UNITED STATES ATLANTIC FLEET

COMSUBLANT 9080.3  
Ser DEP 402/ 8760  
5 Dec 1962

COMSUBLANT INSTRUCTION 9080.3

From: Commander Submarine Force, U. S. Atlantic Fleet  
To: Distribution List

Subj: Shipyard Overhaul; Dock and Sea Trials

Ref: (a) COMSUBLANT INST P5400.4 Series; Subj: COMSUBLANT Regulations  
(b) COMSUBLANT INST 1500.5B NOTAL; Subj: Precommissioning Training of Submarines in Time of Peace  
(c) COMSUBLANT INST 9940.2 Series; Subj: Submarine Salvage Inspection; Standard requirements for

Encl: (1) Minimum Dock Trials  
(2) Minimum Sea Trials  
(3) Additional Dock Trial Tests for Nuclear Submarines

1. Purpose. The purpose of this Instruction is to promulgate check-off lists for dock and sea trials.

2. Inspection and Completion of Shipyard Work. This subject is covered in reference (a).

3. Overhaul Trials, General. An overhaul involves a succession of tests and trials, all culminating in the dock trials, fast cruise, and sea trials near the end of the overhaul. Reference (a) sets forth the general philosophy and sequencing of the various categories of trials, the results of which determine the degree of material excellence achieved by the shipyard and the ship in the conduct of the overhaul. Reference (a) requires that each ship prepare an orderly plan in advance of the scheduled dock and sea trials so that the trials may progress in a thorough and orderly fashion. The ship should consult with the shipyard in preparing this plan. This plan shall include:

- a. A firm time schedule for conduct of all tests.
- b. Responsibility for conduct of each test (shipyard or ship).

EXH 203-1

COMSUBLANT INST 9080.3

c. Pre-requisites for the conduct of each test.

Such a test plan will be invaluable both to the ship and the shipyard in progressing work and ensuring the ship is in fact ready for such major evolutions as dock trials, fast cruise and sea trials.

4. Salvage Inspection. This shall be conducted in accordance with reference (c) and discrepancies corrected prior to commencement of dock trials. It shall be included as an event in the schedule prepared pursuant to paragraph 3.a. above.

5. Overhaul Trials, Specific

a. Dock trials

Enclosures (1) and (3) list the minimum requirements for dock trials.

b. Fast cruise

(1) Submarines will simulate underway conditions to the maximum extent possible and shall particularly emphasize such training as is considered essential by the commanding officer.

(2) Enclosure (4) to reference (b) shall be used as a guide in conduct of fast cruise in nuclear submarines.

c. Sea trials

Enclosure (2) lists the minimum requirements for sea trials in submarines of this Force.

6. Completeness. No ship's overhaul shall be considered complete until all dock and sea trial deficiencies which affect the military characteristics of the ship have been corrected.

b (6)

P. A. BESHANY  
By direction  
Deputy

Distribution List  
See page 3

COMSUBLANT 9080, 3

Distribution List (CSLI 5605.1J):

28K1 ALL COMSUBRONS LANTFLT, COMSUBDEVGRU TWO, COMSUBFLOTS TWO, SIX  
29S ALL SS LANTFLT  
29S4 ALL SSN LANTFLT  
29S8 ALL SSBN LANTFLT

Copy to:

21 CINCLANTFLT  
24Ga COMSUBLANT  
24Gc COMSUBPAC  
32DD ALL AS LANTFLT  
32EE ALL ASR LANTFLT  
J88 OIC SUBSCOL NLON  
J120 FBM S/M TRACEN CHASN  
L30 CO SUBASE NLON  
BUSHIPS  
NAVSHIPYDS PTSMH, NORVA, CHASN, PHILA  
SUPSHIPS NPTNWS, PASCAGOULA, GROTON, CAMDEN, QUINCY  
CO, NAVSTA, KWEST.

Enclosure (1)

COMSUBLANT 9080.3

Minimum Dock Trials

1. Test sound powered phones between all stations.
2. Test MC systems between all stations.
3. Test all alarm circuits at all stations as applicable.
4. Test TP-TR circuits for proper operation.
5. Test all emergency lights.
6. Test ship's whistle.
7. Complete and check a compensation using shipyard design section weight changes. Conduct rough check using draft marks.
8. Check fire control system: Check alignment of periscopes, TBTs and all bearing and range repeaters.
9. Test GSIRs.
10. Operate signal ejectors.
11. a. Check all running lights for brightness and proper lenses.  
b. Start gyro compasses; allow ample time for them to settle out; take an azimuth; check all repeaters.
12. Check service air system.
13. Put a two inch pressure in the submarine and check all compartments for air leaks.
14. Fire inboard slugs from torpedo rooms and conning tower (attack center).
15. Fire water slug and dummy torpedo (where possible) from each torpedo tube (need not be done as part of dock trials so long as accomplished under COMSUBLANT Routine S7505 during overhaul).

Enclosure (1)

Exh 203-4

COMSUBLANT 9080. 3

16. Inspect **b(1)** for paint and sound shorts.
17. Ensure five day supply of oxygen on board and check out oxygen generator, CO2 scrubbers, CO burners, emergency breathing system (if installed), and other atmosphere control equipment and systems.
18. Conduct a normal battery charge using ship's power and equipment. Each main generator and auxiliary generator shall be tested under load. Operate automatic temperature control valves in manual and automatic.
19. Conduct a complete air charge using ship's compressor.
20. Operate all hydraulic plants using each installed pump. Vent the system.
21. Test high pressure and low pressure blow to each tank.
22. Rig FBT for MBT until completion of trials.
23. Operate each main vent in hand and power.
24. Operate each emergency vent. Test for tightness with the main vents open.
25. Operate the main induction in hand and power.
26. Operate the snorkel induction and exhaust valves in hand and power.
27. Operate engine outboard exhaust valves in hand and power.
28. Operate inboard induction flapper valves.
29. Operate safety and negative tank floods in hand and power if applicable.
30. Operate negative tank vent if applicable.
31. Raise, train and lower periscopes, snorkel, radar, antenna masts and all electronic masts as applicable.

Enclosure (1)

2

Exh 203-5

32. Operate EDO fairing if applicable.
33. Lower, train and raise bottomside sonar heads in hand and in power, providing depth of water in berth is sufficient.
34. Test all snorkel safety features in each engine line up simulating at sea environment to the maximum extent possible.
35. Flood and blow all sanitary tanks.
36. Test drain system, taking a suction from each bilge suction as applicable using installed drain pump(s) and, by cross-connecting, the trip pump.
37. Test auxiliary drain system operation (if applicable).
38. Test operation of trim system and pump by pumping to and from each tank, to and from sea and cross-connecting with the drain system.
39. Test operation of portable and installed submersible pumps. Test all submersible pump connections for correct voltage.
40. Operate each lube oil transfer pump.
41. Test the capstan and the anchor windlass.
42. Test bow plane rigging if applicable.
43. Test bow (sail) and stern plane tilting in hand, normal power, and emergency and observe normal and emergency plane angle indicators working correctly.
44. Test steering in hand, normal power, and emergency observing normal and emergency rudder angle indicators.
45. Test motor order telegraph if applicable.
46. Test engine order telegraphs.
47. Test main shaft/shafts in each direction at one-third speed on both batteries and generators. (Nuclear submarines test on main engines and EPM). Observe operation of each main motor circulating

COMSUBLANT 9080.3

water pump. Make proper adjustments of stern tube packing. Ships with syntron, sealol, and inflatable seals insure proper line-up before turning shaft. Check shaft seals for leakage.

48. Test all **b(3) 10 USC 130** MG sets. Operate sets in parallel where paralleling is provided.

49. Operate vapor compressors and make battery water. Check fresh and battery water systems. (Do not use contaminated water).

50. Test degaussing system (if installed).

51. Conduct tests to insure the proper operation of all electronic equipment paying particular attention to frequency adjustments, power out-put and proper sensitivity. In addition, where bearing, range, or depth information is provided by equipment it must be determined that this data is within specifications.

Enclosure (2)

COMSUBLANT 9080.3

MINIMUM SEA TRIALS

In general, trials should be conducted within phases indicated. However, when operational or schedule requirements dictate transfer of a particular trial, or trial item, so long as safety is not compromised, the Commanding Officer of the ship should do so.

A. Phase I, Prior to Diving (enroute area)

1. Run up to full power long enough for temperatures to reach stable value.
2. Run astern up to full power or maximum safe speed as applicable.
3. Ahead flank to back emergency.
4. Post a man by the stern tubes to inspect and ensure proper adjustment of packing glands and circulating water.
5. Test log using measured mile or navigational fixes to determine accuracy.
6. **b(3) 10 USC 130**
7. Take and compare a LORAN fix and a navigational fix.
8. Test accuracy of all bearing transmitters and indicators. Check radar and sonar bearings against visual bearings for accuracy.
9. Check operation of all radars.
10. Test all radio transmitters, receivers, and electronic equipment.
11. Conduct firing test of submerged signal gun.
12. Test all bottomside sonars. Establish sonar communications with escort.
13. Test bow (sail) and stern plane rigging and tilting.
14. Flood variable tanks to the computed compensation.

Enclosure (2)

*Exh 203-8*

COMSUBLANT 9080.3

15. Test fathometer.

16. Record megger readings of all antennas.

B. Phase II, Test Dive for Tightness

1. Conduct running dive to periscope depth in minimum depth of water in which ship can be safely maneuvered and salvage operations conducted. All hands shall be stationed throughout the ship to inspect for leaks and correct them.

2. Establish 1/3 speed trim.

3. Operate the main motors at the one-hour discharge rate for ten minutes.

4. Test all sonar equipment.

5. Operate periscopes, checking optics, radar and leakage.

6. Snorkel on each engine designed for snorkeling. Check operation of electrodes.

7. Pump bilges in all compartments.

8. Fire water slug from each torpedo tube, testing the fire control installation.

9. Check operation of underwater telephone from each control station. Check operation of each emergency underwater telephone ensuring that each hydrophone is used.

10. Vent the fuel system.

C. Phase III. Enroute to Area for Deep Dive

1. Operate the stills; produce battery water.

2. Check IFF equipment with another vessel or aircraft if available.

3. Operate ECM equipment.

4. In addition to the above requirements, each ship shall have, as as a minimum requirement, a VENUS crypto security capability during sea trials.

Enclosure (2)

2

Exh 203-9

D. Phase IV. Deep Dive

1. Establish stop trim. Take readings and water samples required to make a check of the ballasting.
2. Conduct deep dive to test depth with all hands stationed throughout the ship to inspect for leaks and correct them. Perform tests specified by BUSHIPS Technical Manual, Article 11-124.
3. Check operation of Noise Level Monitor and Cavitation Indicator. Compare readings with pre-overhaul readings and record in log.
4. Check operation of Sonar Test Target, comparing sensitivity on sonars with pre-overhaul calibrations and comparing bearings with measured bearings.

E. Phase V. After Dive

1. Note condition of periscope optics.
2. Measure resistance to ground of all external electrical cables.
3. Take radio antenna megger readings immediately on surfacing, again after one-half hour, compare with readings taken before diving.
4. Test all electronic equipment for proper operation.

Enclosure (3)

COMSUBLANT 9080.3

ADDITIONAL DOCK TRIAL TESTS FOR NUCLEAR SUBMARINES

1. Long form pre-critical check-off.
2. Conduct all other necessary propulsion plant pre-critical check-offs.
3. Reactor startup.
4. Plant startup and shutdown (including changing speed of coolant pumps).
5. Taking on shore power.
6. Check out emergency or auxiliary propulsion motors where installed.
7. Diesel snorkel (including carrying full electrical load on the diesel).
8. Take samples and perform all plant chemistry analyses.
9. Startup, run and shutdown the steam and vapor compression distilling plants.
10. Make up and test all temporary hose connections such as for sea chest blow, transfer of potable water to reserve feed via the demineralizer, steam heat lube oil, etc.
11. Operate propulsion plant in various modes **b(3) 10 USC 130**
12. Degasify and charge **b(3) 10 USC 130**
13. Conduct boiler blowdown and chemical addition.
14. Check gyro stabilizer operation.
15. Check manual override operation of hydraulic or electrical operated valves.

Enclosure (3)

*Exh 203-11*

COMSUBLANT 9080.3

16. Simulate the following casualties and recovery procedures:

- a. Full scram.
- b. b(3) 10 USC 130
- c. b(3) 10 USC 130
- d. Loss of fresh water cooling.
- e. Shield tank low level.
- f. High iodine in the primary coolant.
- g. Stuck control rod.
- h. Primary coolant leak.
- i. Pump noise monitor and pump TM alarms.
- j. Radiation casualties.
- k. Low pressure accident (loss of coolant) (include dry runs of all known methods of supplying water to the reactor plant).
- l. Reactor plant pressure and temperature alarms.
- m. Loss of main/shaft/SSTG lube oil.
- n. Loss of vacuum, (1) loss of circulating pump, (2) air binding.
- o. Loss of T-G.
- p. Loss of feed pump.
- q. High and low steam generator water level.
- r. High salinity (steam generator, condensate, reserve feed).
- s. Loss of air conditioning.
- t. Loss of auxiliary salt water.
- u. Major steam leak.

Enclosure (3)

2

Exh 203-12

3 FEB 61

Unclassified

PRIORITY

P 031916Z

FROM: DEPCOMSUBLANT

TO: BUSHIPS

INFO: COMNAVSHIPYD PTSMH  
COMSUBLANT

Unclassified

INSPECTION SILBRAZE PIPE FITTINGS

1. VIEW SILBRAZE FITTING FAILURE IN BARBEL, DEFICIENCIES FOUND DURING INSPECTION BARBEL SALTWATER SYSTEM, AND DEFICIENCIES OBSERVED THESE FITTINGS IN ABRAHAM LINCOLN DURING BUILDER'S TRIALS, REQUEST REINSPECTION EARLIEST SALTWATER SYSTEMS ABRAHAM LINCOLN AND THRESHER TO INSURE SYSTEMS SAFE FOR SEA TRIALS AND ULTIMATE UNRESTRICTED OPERATIONS. THE IMPORTANCE OF MEETING ABRAHAM LINCOLN AND THRESHER DELIVERY DATES NEEDS NO EMPHASIS. CAPT KERN, MY STAFF, WILL ATTEND BUSHIPS CONFERENCE 7 FEB IN CONNECTION WITH THESE MATTERS.

Copy in 602 + 593 S.1.6  
date

N4 - 0121 (S.1.6)

*[Handwritten signature]*

ORIGINATOR \_\_\_\_\_

RELEASED \_\_\_\_\_

EXH 204

031936 FEB

MARE ISLAND NAVAL SHIPYARD  
VALLEJO, CALIFORNIA

IN REPLY REFER TO  
9480/SS  
(216-7720)

APR 12 1962

From: Commander, Mare Island Naval Shipyard  
To: Chief, Bureau of Ships

Subj: Silver-Brazed Sea Water Systems, procedures during overhauls on  
submarines; comments on

Ref: (a) BUSHIPS Ltr 9480 Ser 648X-160 of 13 Feb 1962  
(b) NAVSHIPS 250-637-2, NAVSHIPS 250-648-8

1. Reference (a) invited comments concerning the enclosed recommended inspection procedures for submarines during overhaul.

2. Mare Island concurs with enclosure (1) of reference (a), except as follows:

a. Paragraph 1a specifies visual inspection of joints 2" I.P.S. and larger. Experience gained during overhaul of USS SCULPIN (SSN 590) indicates the need for inspection of joints 1" I.P.S. and larger. On SCULPIN, joints in sizes 1" I.P.S. and above were visually inspected, with the following results:

- (1) 1779 joints visually inspected
  - 289 joints suspect by visual
  - 387 joints ultrasonic tested (includes the 289 above)
  - 86 joints rejected by "U.T."
  - 23 of the above 86 joints were smaller than 2" I.P.S.
  - 251 joints removed in order to renew 86 joints rejected by U.T.

(2) It is recommended that paragraph 1.a be changed to require visual inspection of joints 1" I.P.S. and larger.

b. Recommend that paragraph 1.b.2 restrict 40 percent minimum average bond to SSN 583 Class test depth submarines and add 50 percent minimum average bond for SSN 593 Class test depth submarines.

3. Reference (a) states most important changes to NAVSHIPS 250-637-2 include requirement for radiographing all field-made joints above 2 inches. Actually, paragraph 1.9.3 of NAVSHIPS 250-637-2 states, "Joints over 2" I.P.S. in submarine sea water systems which are brazed in position on the ship shall be radiographed or subjected to an approved non-destructive test." Paragraph 4 of reference (a) also states, "In addition to radiography, ultrasonics has been developed to a point where it can be used." Therefore, it is recommended that paragraph 1.9.3 of NAVSHIPS 250-637-2

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6735

EXH 205

9480/SS  
(216-7720)

be revised to read, " - - - shall be radiographed and/or ultrasonic tested as required after inspection in accordance with NAVSHIPS 250-648-8."

NAVY DEPARTMENT, WASHINGTON, D.C.  
Administrative Officer

Copy to:  
→ DEPCOMSUBLANT  
COMSUBPAC  
PTSMTH NAVSHIPYD  
SUPSHIP GROTON  
SUPSHIP NPTNWS  
SUPSHIP QUINCY  
SUPSHIP CAMDEN  
SUPSHIP PASCAGOULA

Unclassified

DEPARTMENT OF THE NAVY  
Office of the Chief of Naval Operations  
Washington 25, D. C.

*Verfa #1*  
*Capt Kern*  
OPNAV 09010.119A  
Op-43  
Ser 01328F43  
6 May 1958

**OPNAV INSTRUCTION 09010.119A**

From: Chief of Naval Operations  
To: Distribution List

Subj: Submarine Attack Type (SS(N)), SCB Project No. 168; approved characteristics for

Encl: (1) Subject characteristics

1. Purpose. This Instruction promulgates the approved characteristics for Submarine Attack Type (SS(N)), SCB Project No. 168.

2. Cancellation. This Instruction cancels and supersedes OPNAV INSTRUCTION 09010.119 of 26 July 1957.

3. Applicability. These characteristics are applicable to SSN 593 FY 1957 Shipbuilding Program and to the attack submarines in the FY 1959 and FY 1960 Shipbuilding Programs.

RALPH E. WILSON  
Deputy Chief of Naval Operations  
(Logistics)

**FILE COPY**  
**RETURN TO CODE 865**

AUTHENTICATED:

b (6)

*H. M. DAVEY, JR.*  
CDR, USN

*Copy to 241E*  
Distribution:  
(see next page)

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Enclosure (2) to CNO ltr  
ser c 446246700024 Aug 59

EXH 206-1

Unclassified

OPNAVINST 09010.119A

6 May 1958

Distributions:

SNDL:

B3 (less Nat'l War College)

21 (Cdr-in-Chief)

24G (Submarine Force Cmdr) (10)

26F (COMOPDEVFOR)

F26 (Inspection & Survey Dds)

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A5 (BUSHIS (60), BUORD (15), BUORD (87, Code 132)

BUSANDA (5), BUPERS (5),

BUAER (6), BUMED (2) only)

A2A (ONI, ONR, COMPT (2) only)

QASD (AE) Marine Craft Div.

Ops-25

C3B(2)

C3

30

303L

31(4)

33(2)

34(7)

36

40(2)

403C

405G

41

44

45(2)

431(15)

433(15)

05(2)

50

55

552

51

58

60(2)

008

09D

93B

10(2)

Unclassified

EXH 206-2

ENCLOSURE (1)

Unclassified

APPROVED CHARACTERISTICS  
SUBMARINE ATTACK TYPE  
SCB PROJECT NO. 188

OPNAVINST 09010.119A  
6 May 1958

1. Mission

To locate and destroy all types of ships.

2. Designed Tasks

a. To locate and destroy submarines.

b. To locate and destroy surface ships.

3. Contingent Tasks

As developed.

4. General Discussion of Design

This design is intended to produce a reactor powered attack type submarine in which the best possible submerged characteristics are realized. High submerged speed as well as great submerged maneuverability and endurance are to be emphasized in order to provide a vehicle for the employment of advanced tactical methods. The best possible sonar performance at high submerged speeds is required. The design is to emphasize heavily the elimination of self and radiated noises. Surface performance characteristics are purely secondary.

5. Hull Characteristics

a. Approximate displacement and dimensions:

Displacement, light	-	3450 tons
Displacement, submerged	-	4300 tons
Length	-	278½ feet
Beam	-	32 feet

b. Maximum practicable explosive shock resistance in the hull, the equipment, and the equipment mountings is desired. Other damage control devices are to be in accordance with established submarine practice. //

c. Silencing: A maximum effort shall be made to reach or exceed the goals specified in Development Characteristics AS16102-1 as follows:

b(1)



Unclassified

ENCLOSURE (1)

EXH 206-3

Unclassified

OPNAVINST 09010.119A  
6 May 1958

(2) Radiated noise level shall be below the spectrum level

b(1)

d. To the greatest practicable degree the forward and stern planes, the propeller, and any other projecting hull appurtenance shall be designed to eliminate turbulence and the fouling of moored mine cables.

e. The test depth shall be b(1)

#### 6. Special Features

a. Two escape compartments shall be provided. The bulkheads of these compartments shall be capable of withstanding flooding to b(1) feet. Other internal structural bulkheads shall be capable of withstanding flooding to 300 feet. ||

b. Two submarine messenger buoys shall be provided. The stowage shall be designed to permit effective fairing of the hull when the buoys are removed. ||

c. The bow shall be devoted primarily to sonar.

#### 7. Armament

a. Torpedo tubes: Four 21-inch torpedo tubes shall be installed pointing forward abaft the sonar bow. These shall be capable of firing any submarine torpedo, mine or tube-launched missile which is electrically set. Hydraulic ejection to test depth is required.

b. Torpedoes: Stowage shall be provided for 19 r 1 torpedoes or missiles, 246 inches or less in length. The arrangement shall provide alternate stowage for 36 reload torpedoes of 135-inch length.

c. Mines: Within the limitation of the torpedo stowage described, arrangement shall be made for the alternate stowage of the maximum number of submarine mines.

d. Torpedo handling: Equipment for powered handling of torpedoes or racks in the vertical and fore-and-aft direction shall be provided in order that reloading the tubes may be very rapid. Adequate control of weapon handling in the athwartship direction shall be provided. It is not necessary that powered fore-and-aft motion be adaptable to small torpedoes or mines. The design of the torpedo tubes, their accessories, piping and tankage shall place emphasis on reloading speed.

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e. Fire control: A Fire Control System Mk 112 shall be installed to provide electrical settings and wire guidance data for torpedoes. This system shall be compatible with the Integrated Sonar including PUFFS. Space equivalent to that occupied by the Mk 112 system, shall be reserved for the installation of additional fire control equipment for the tube launched missile.

8. Communications and Electronics

a. The electronics installation shall be in accordance with the Electronics Installation Plan, Appendix (1).

b. Retractable masts associated with the electronic equipment shall be installed as follows:

	Maximum Speed of Ship	
	Raise & Lower	Use
Mast 1 - Surface search radar	6 kts.	6 kts.
Mast 2 - VLF loop antenna	15 kts.	15 kts.
Mast 3 - Retractable MF/HF whip antenna	16 kts.	16 kts.
Mast 4 - UHF antenna and IFF transponder	16 kts	16 kts.
*Mast 5 - ECM antenna	6 acceptable 15 desired	6 acceptable 15 desired

\* See para. 12 b.

All of the above masts shall be usable at such depth as will permit the exposure of not more than 10 feet of the periscope.

9. Propulsion and Engineering Features

The engineering plant shall provide:

a. Maximum speed capabilities:

b. Endurance:

b(3) AEA

Diesel fuel - 2250 miles at about 5 knots.

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j. Power plants: A single screw nuclear main propulsion plant shall be installed. In addition, a battery shall be installed for reactor starting, auxiliary load, and emergency propulsion. One diesel-electric generator, capable of snorkel propulsion at a speed of about 5 knots, battery charging or reactor start-up shall be installed. A retractable motor for maneuvering and emergency propulsion shall be installed.

d. The snorkel shall be sufficiently large to permit full power diesel operation and recharging of the air banks to the full capacity of the compressors. It shall be capable of being raised and operated at a speed of at least 6 knots.

e. Distilling plant: Suitable evaporators to provide 20 gallons of water per man per day, battery water, and makeup feed water for the power plant, shall be provided.

#### 10. Protection

None.

#### 11. Aviation Features

None.

#### 12. Command and Ship Control

a. Bridge: A bridge capable of accommodating two men shall be provided.

b. (1) A radar and ECH type periscope (incorporating navigating features) shall be fitted. The upper lens of the periscope fully extended shall be about 18 feet above the highest fixed point of the sail. It shall have aided power training and shall be capable of being raised, lowered, and used at speeds up to 6 knots. In order to give the required exposure at snorkelling depth, the periscope shall be operable from two height positions.

(2) Provision shall be made for substitution of a similar periscope for Mast 5. Only one operating position is required.

c. Combined depth-control and course-control equipment shall be provided.

d. Suitable sonar plotting facilities shall be provided in or near the attack center.

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